

UNHOLTZ-DICKIE CORPORATION

VIBRATION TEST SYSTEMS & MEASUREMENT INSTRUMENTATION

OPERATING INSTRUCTION MANUAL
MODEL TF22, SN 167 & 168

OPERATING AND SERVICING INSTRUCTIONS

MODEL TF22

TRACKING FILTER

SERIAL NUMBER 167 & 168

UNHOLTZ-DICKIE CORPORATION
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UNHOLTZ-DICKIE CORPORATION MODEL TF22 TRACKING FILTER

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1. GENERAL DESCRIPTION AND INTRODUCTION

Any vibration test that requires filtering of one acceleration channel, should have filtering available on all channels. The TF22 has been designed as a compact economical instrument to provide the same performance at one-half the price and one-sixth the panel space of competitive units. It offers improved performance over the earlier TF11.

The TF22 is a unity-gain Tracking Filter with continuous variable constant 10% bandwidth. The upper and lower bandwidth limits are adjustable. A fixed bandwidth from 2 Hz to 200 Hz can be selected. Fig. 1.1 shows the front of the TF22, and a block diagram of a typical test setup is shown in Fig. 1.2. Oscillators other than the U-D Model OSC-1 may require certain precautions listed in Section 4.6.

Interchangeable mounting with Model D22 Charge Amplifiers allows the TF22 to be mounted next to the corresponding Amplifier in a multichannel system.

Utilizing the low distortion output from the OSC-1 Sweep Sine Generator, the TF22 has no unnecessary duplication of circuitry. Co-Quad circuitry eliminates the possibility of "loss of lock" at high sweep rates or low input levels.

The OVERLOAD detector on input is connected to system interlock to prevent run away of system. The RANGE, BANDWIDTH and BYPASS switches are also connected to the interlock.

In the BYPASS mode, the rear filter OUTPUT is connected directly to the INPUT and the interlocks are bypassed to allow the TF22 to be used as a monitor. The front panel OUTPUT remains connected to the filtered unity gain output.

NOTICE: For operation with Tuning generators other than OSC-1 after SN 155 see Section 4.6 of this manual.

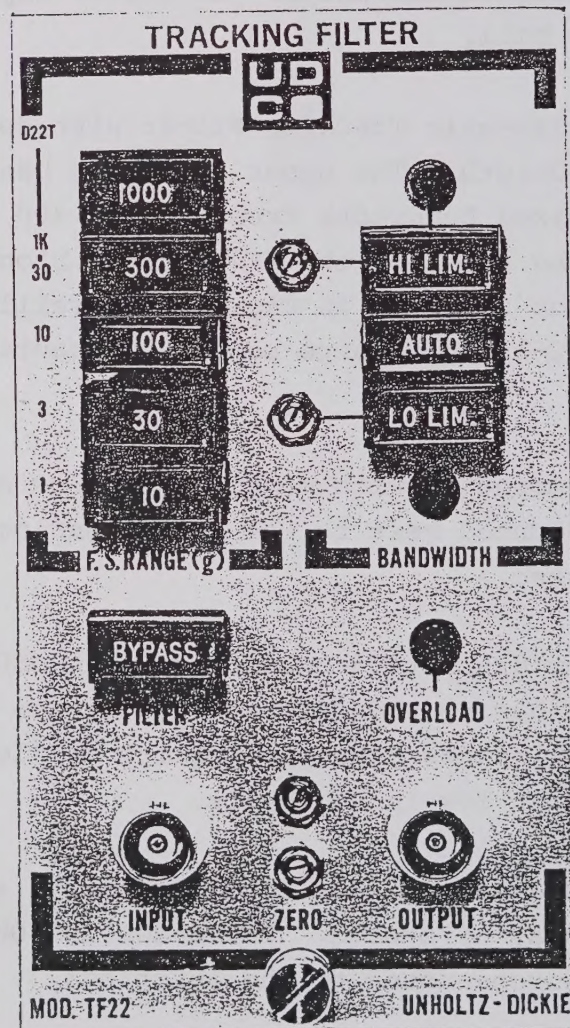
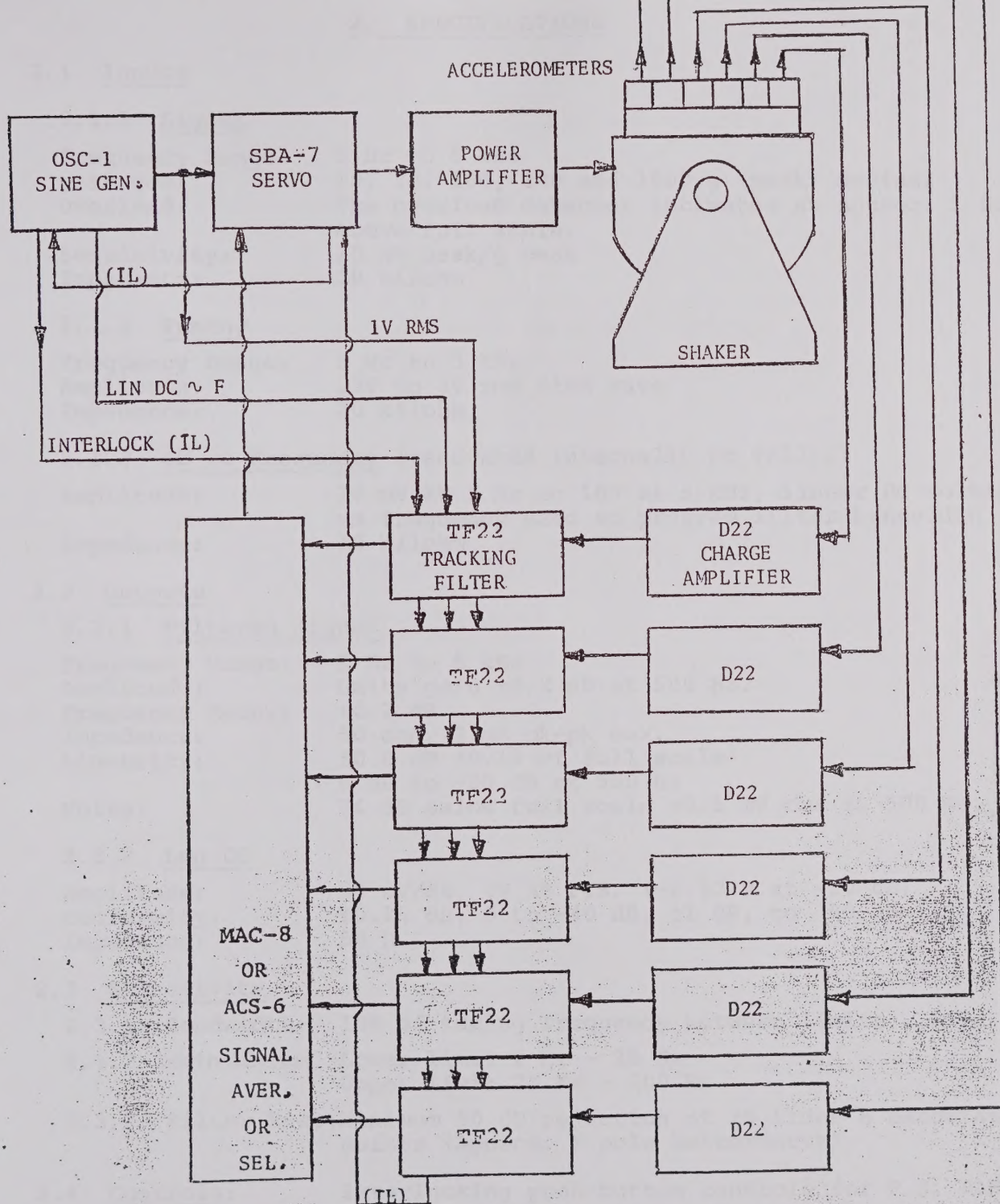


Fig. 1-1
Front View of TF22



TYPICAL TEST SETUP WITH TF22

FIG. 1.2



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2. SPECIFICATIONS

2.1 Inputs

2.1.1 Signal

Frequency Range: 5 Hz to 5 kHz
g ranges: 10, 30, 100, 300 and 1000 g (peak) nominal
Overload: The overload detector activates at approx. 1 dB above full scale.
Sensitivity: 10 mV peak/g peak
Impedance: 20 kilohm

2.1.2 Tuning

Frequency Range: 5 Hz to 5 kHz
Amplitude: .3V to 3V rms sine wave
Impedance: 20 kilohm

2.1.3 DC vs Frequency (generated internally on TF22-L)

Amplitude: 10 mV at 5 Hz to 10V at 5 kHz, linear DC voltage vs frequency used to program filter bandwidth
Impedance: 10 kilohm

2.2 Outputs

2.2.1 Filtered Signal

Frequency Range: 5 Hz to 5 kHz
Amplitude: Unity gain ± 0.2 dB at 500 Hz.
Frequency Resp.: ± 0.2 dB
Impedance: 50 ohm, 2 mA pk-pk max.
Linearity: ± 0.2 dB $\pm 0.1\%$ of full scale
0 dB to -50 dB at 500 Hz
Noise: 74 dB below full scale ± 0.1 mV rms at 500 Hz.

2.2.2 Log DC

Amplitude: 50 mV/dB, 0V at F.S. (-2.50 V at -50 dB)
Conformity: ± 0.25 dB, 0 to -40 dB, ± 1 dB, to -50 dB
Impedance: 50 Ω

2.3 Selectivity

2.3.1 Bandwidth: 10% of tuning frequency between limits

2.3.2 Bdwth Limits: Lower limit 2 Hz - 20 Hz
Upper limit 20 Hz - 200 Hz

2.3.3 Filter Resp: Minimum 50 dB rejection at ± 8 times $\frac{1}{2}$ bandwidth points (Approx. 3 pole Butterworth)

2.4 Controls: Interlocking push-button controls for F.S. RANGE, and BANDWIDTH selection. Green background shows active push-button. Filter IN/BYPASS control shows green background in BYPASS position.

2.5 Indicators

2.5.1 Overload(Red): Indicates overload of input

2.5.2 Lo Limit(Green): Indicates BW is fixed at lower limit

2.5.3 Hi Limit(Green): Indicates BW is fixed at high limit

- 2.6 Interlocks : All switches, when changed, provide a signal to place vibration system into STANDBY (no vibration).
- 2.7 Connectors:
- 2.7.1 Inputs and Outputs: Rear BNC connectors plus parallel front BNC connectors for input signal and filtered output signal.
- 2.7.2 Aux. Control: Multipin "D" series rear connector for interlocks and for patching tuning and DC inputs between modules in a multiple channel installation.
- 2.8 Signal Ground: A switch on the rear panel selects the signal ground to be connected to the AC line ground or to be floating. (Connected to AC line ground in another chassis.)
- 2.9 Physical:
- 2.9.1 Power: 105-125/210-250 V AC, 50-60 Hz approx. 10 VA.
- 2.9.2 Weight: 6 lb.
- 2.9.3 Size: 5.25 H x 2.8 W x 18" D excluding connectors. Uses Model 22RA Rack Adapter for six channels.
- 2.9.4 Finish: Front Panel-Amco Light Grey Metallic paint. Grey Vinyl-Covered Chassis.
- 2.10 Options:
- | | |
|---------------|---|
| -L | Internal frequency to linear DC voltage converter for constant % BW control |
| -SR | Sine reject output added for combined sine/random testing |
| Phase matched | Channels matched within $\pm 1^\circ$ phase similarity from 5 to 5000 Hz |
| -8 | 8 3/4" front panel height to match -8 charge amplifier modules |
| -P | Random Spectral Analyzer |
| -F2 | 2-2000 Hz range, 10% bandwidth |
| -F1 | 1-1000 Hz range, 10% bandwidth |
| -BW5 | 5% Bandwidth |

3. DESCRIPTION OF CONTROLS AND CONNECTORS

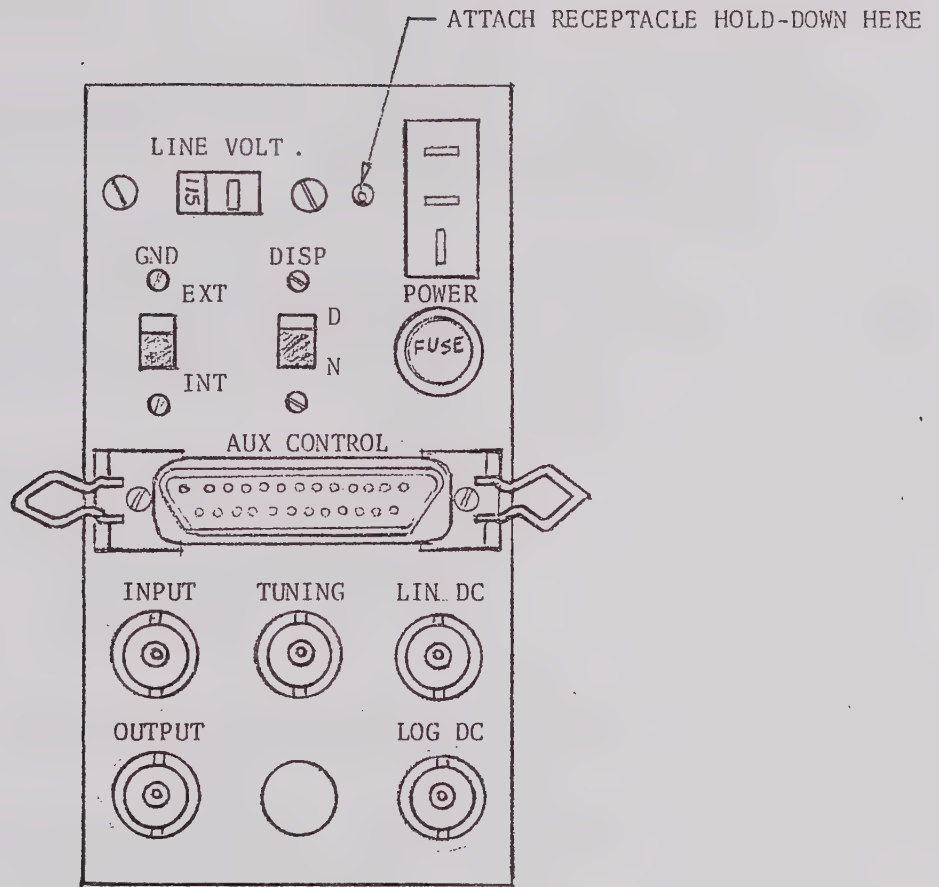
3.1 Front Panel (See Fig. 1.1)

- 3.1.1 F.S. RANGE - These 5 interlocking pushbuttons select the optimum operating range of 10, 31.6, 100, 316 or 1000 g peak (10 mV/g). Each range has an approximately 2 dB over range before the OVERLOAD activates the interlock to allow for some distortion and/or noise signal in addition to a full scale input sine signal. A green background indicates the active range.
- 3.1.2 OVERLOAD Indicator - This red LED indicator flashes when peaks of the input signal exceed full scale plus approximate 1 dB of the selected F.S. RANGE.
- 3.1.3 FILTER IN/BYPASS - In the FILTER IN position (pushbutton OUT) the signal OUTPUT on the rear of the TF22 is connected to the unity gain filtered signal. In the BYPASS position (pushbutton IN) the signal OUTPUT is connected to the signal INPUT: the TF22 is deactivated in the BYPASS mode. A green background indicates the BYPASS condition.
- 3.1.4 BANDWIDTH Mode Selector - Three interlocking pushbuttons which select the mode in which the bandwidth changes with change of the tuning frequency. The active mode is shown by a green background.
- LO LIMIT - The bandwidth is fixed 2-20 Hz as selected by the LO LIMIT control.
- AUTO - The bandwidth changes automatically as the tuning frequency changes between the limit selected by the LO LIMIT and HI LIMIT controls.
- HI LIMIT - The bandwidth is fixed 20 - 2000 Hz as selected by the HI LIMIT control.
- 3.1.5 LO LIMIT Indicator - Green LED lights when the BW is fixed at the LO LIMIT.
- 3.1.6 LO LIMIT Selector - This screw driver adjustment selects the LO LIMIT Bandwidth 2-20 Hz.
- 3.1.7 HI LIMIT Selector - This screwdriver adjustment selects the HI LIMIT Bandwidth 20-200 Hz.
- 3.1.8 HI LIMIT Indicator - Green LED lights when the BW is fixed at the HI LIMIT.
- 3.1.9 INPUT - This connector is in parallel with the rear INPUT and is intended for monitoring purposes.

- 3.1.10 ZERO - These screw driver adjustments are made easily accessible for the operator to adjust for optimum dynamic range.
- 3.1.11 OUTPUT - This connector makes the filtered unity gain accessible for monitoring purposes regardless of the position of the FILTER IN/BYPASS pushbutton.

3.2 Rear Panel (See Fig. 3.1)

- 3.2.1 POWER - 3-prong connector for AC power input mates socket in U-D Model 22RA Rack Adapter.
 - Pin 1 (bottom) AC ground
 - Pin 2 (center) AC common
 - Pin 3 (top) 115 V/230 V AC 50/60 Hz
- 3.2.2 FUSE - GMW-1/2
- 3.2.3 EXT GND/INT GND Selector - Connects signal common of TF11 to Power Ground (INT) or isolates it (EXT)
- 3.2.4 AUX. CONTROL - A 25 pin rear panel connector provides for auxiliary system interconnections as described in the following list. (See Table 3.1 for Pin Function)
- 3.2.5 INPUT - Unfiltered Signal Input
- 3.2.6 OUTPUT - Signal Output is connected either to unfiltered Signal Input (BYPASS) or to unity gain filtered output (FILTER IN).
- 3.2.7 TUNING - Input for reference AC signal OSC-1; used to tune the TF22. (.3V - 3V rms)
- 3.2.8 LIN DC - Input for 10 mV to 10 V DC (2 mV/Hz) signal from OSC-1; used to adjust to bandwidth of the TF 22 in the AUTO BW mode. On TF22-L this signal is generated internally and available on LIN DC connector for interconnection to other TF22's without "-L" option.
- 3.2.9 LOG DC - Output for DC signal proportional to the log of the full scale filtered AC; may be used to plot the filtered signal on an X-Y Plotter.
- 3.2.10 DISPLACEMENT Mode Switch
 - D Position: DISPLACEMENT MODE
 - N Position: NORMAL



REAR VIEW TF22

FIG. 3.1

TABLE 3.1
AUX. CONTROL PIN FUNCTION

<u>PIN NO.</u>	<u>FUNCTION</u>
1 & 14	TUNING - Reference AC Input, from OSC-1 Sweep Sine Generator tunes the filter. This connection is in parallel with TUNING BNC connector and may be used to patch tuning signal between TF22's in a multi-channel system (0.3 to 3V rms.)
2 & 15	LIN DC - 10 mV to 10 V DC Input signal, proportional to frequency (2mV/Hz) adjusts Bandwidth of TF22 in AUTO BW mode. This connection is in parallel with LIN DC BNC connector and may be used to patch the LIN DC signal between TF22's in a multi-channel system (see Fig. 4.1). On the TF22-L this is an output signal.
3 & 16	SINE - normalized reference AC Sine signal. May be used to slave a TF22 without A-TF22 Board. (5V rms)
4 & 17	COSINE - Normalized reference AC cosine signal; may be used to slave a TF22 without A-TF22 Board. (5V rms)
5	BW CONTROL - 40 mV-4V DC proportional to Bandwidth; may be used to slave limit controls in a multichannel system.
12 & 13	COMMON for LIN DC and TUNING signals, 50 Ω to internal SIGNAL GND.
24 & 25	INTERLOCK - Used as an external series interlock connection, usually connected in series with the internal interlock series or a vibration excitor control servo (SP-7). The connection between 24 and 25 is NC and opens momentary when either of the RANGE or BANDWIDTH or FILTER IN/BYPASS controls is changed. Also, the connection is momentarily interrupted when the OVERLOAD detector is triggered. In BYPASS the interlock is held closed.

3.2.10 (cont'd)

In the DISPLACEMENT Mode the TF22 goes automatically into BYPASS when the BANDWIDTH switch is in AUTO and the LO LIMIT light is on and the RANGE switch is in 100, 300 or 1000 g. (See also Section 4.8)

Notice that the front OUTPUT is always connected to the filtered signal.

- 3.2.11 LINE VOLT. - This screwdriver actuated switch is used to select operation with either 115 V or 230 V AC line voltage.

4. OPERATION

This section describes the operation of the TF22 in typical systems. If the TF22 is purchased as part of a large system, refer to the systems manual for specific installation, calibration and operating instructions.

4.1 Operational Checkout Procedure

Sections 6.1 through 6.3 can be used as a quick initial check-out procedure.

4.2 System Interconnection for Multiple TF22's

Fig. 1.2 shows a typical system using several channels of Tracking Filters. Fig. 4.1 shows the interconnection of the control signals (TUNING SIGNAL, LIN DC vs FREQ., INTERLOCK). All interconnections between TF22's are made through the AUX CONTROL connector.

The TUNING signal and the LIN DC v. FREQ. signal can be connected to any of the interconnected TF22's.

4.3 System Grounds (Line Frequency Interference)

4.3.1 INT - EXT GROUND - Like most instruments manufactured by Unholtz-Dickie Corp. the TF22 has isolated signal common, which can be connected to the Power Ground (Chassis) by a switch at the rear panel. In a system usually only one instrument is grounded INTERNAL, all others being grounded EXTERNAL (through the shields of the interconnecting cables). Which instrument should be grounded is usually determined by trial.

4.4 Output ZERO

Before using the TF22, the output may have to be re-adjusted for Zero feedthrough of the tuning signal. Although the instrument usually settles within several minutes after power is turned on, it is advisable to allow 15 minutes warmup for operation over the full dynamic range.

4.5 Adjustment of Bandwidth Limits

The limits of the constant percentage (10%) bandwidth range may be adjusted by using the LO LIMIT and HI LIMIT screw-driver adjustments. To set limits, push to AUTO and select on SINE GENERATOR a frequency of 10 times the desired bandwidth limit. Adjust screw driver adjustment until LIMIT indicator just lights.

Notice: An ideal bandpass cannot be operated at a center frequency below $\frac{1}{2}$ of the bandwidth. Typically in a 3-pole pair tracking filter such as the TF22, an output error in excess of .5 dB is observed at tuning frequencies less than .65 X BW.

4.6 Sine Generators Other Than OSC-1 After SN 155

The TF22 Tracking Filter is designed to be used with the OSC-1 Sine Generator on range 5 Hz to 5 kHz. When used otherwise the following precautions must be considered.

- 4.6.1 OSC-1 Before SN 156 on RANGE 2 Hz - 2 kHz - The LIN DC output on any RANGE is 10 mV - 10 V; therefore on RANGE 2 kHz the AUTO bandwidth will be 25% instead of 10% and the frequency range of the LO LIMIT and HI LIMIT controls will be 8 Hz to 80 Hz and 80 Hz to 800 Hz. On OSC-1's after SN 155 the LIN DC on any RANGE is 2 mV/Hz to insure proper operation.

Solution: Use on RANGE 5 kHz only or consult factory FOR MODIFICATION OF LIN DC output (or use TF22-L).

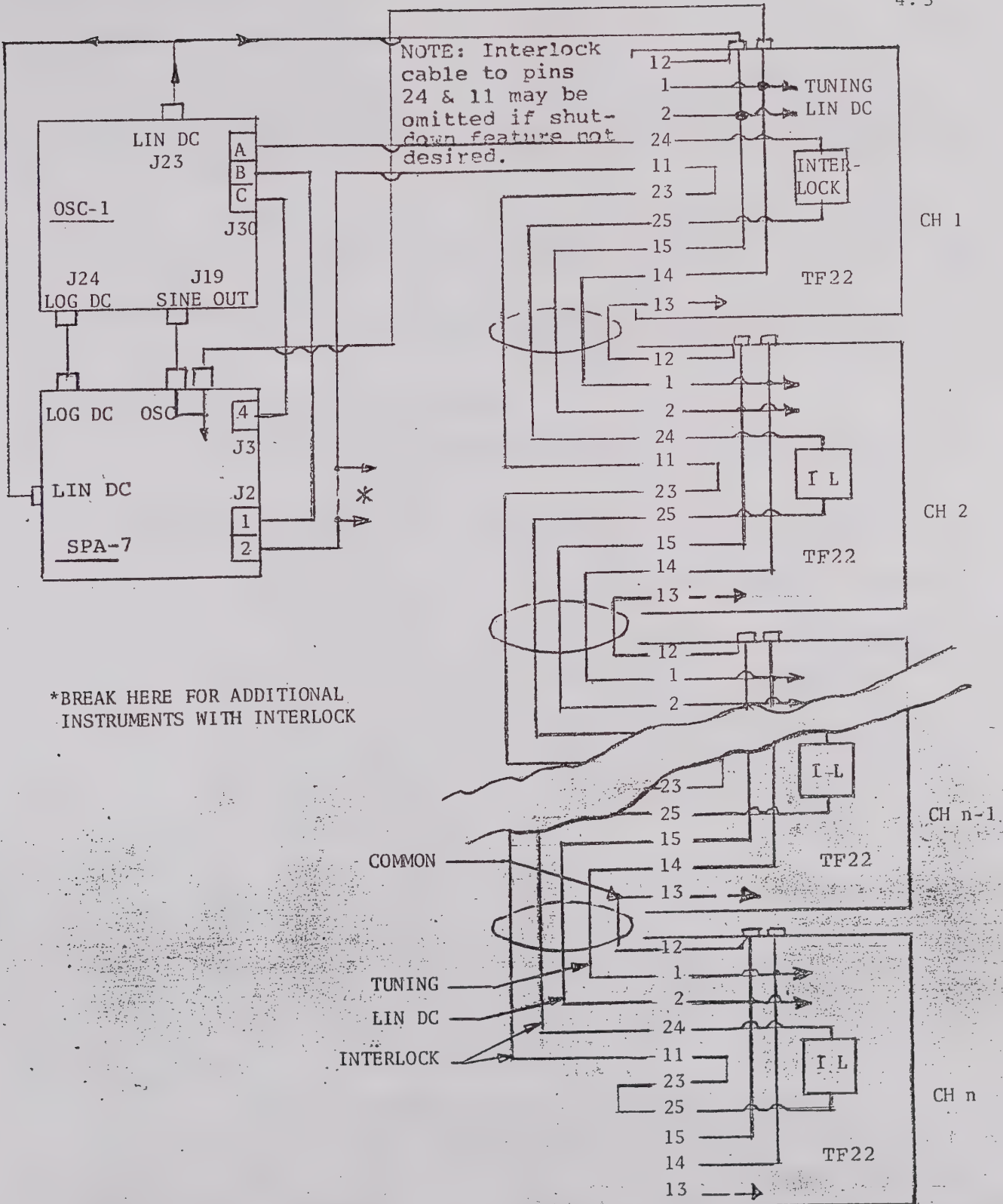
- 4.6.2 SD104A-5 on Ranges other than X1 (5 kHz) - Synonymous to 4.6.1 the bandwidth control will work properly only on the 5 kHz range (MULTIPLIER X1).

Solution: Use on MULTIPLIER X1 only or use TF22-L (with Internal LIN DC generator).

- 4.6.3 SD104A-1 and SD104A-2 - Synonymous to 4.6.1 no MULTIPLIER setting will yield proper bandwidth control.

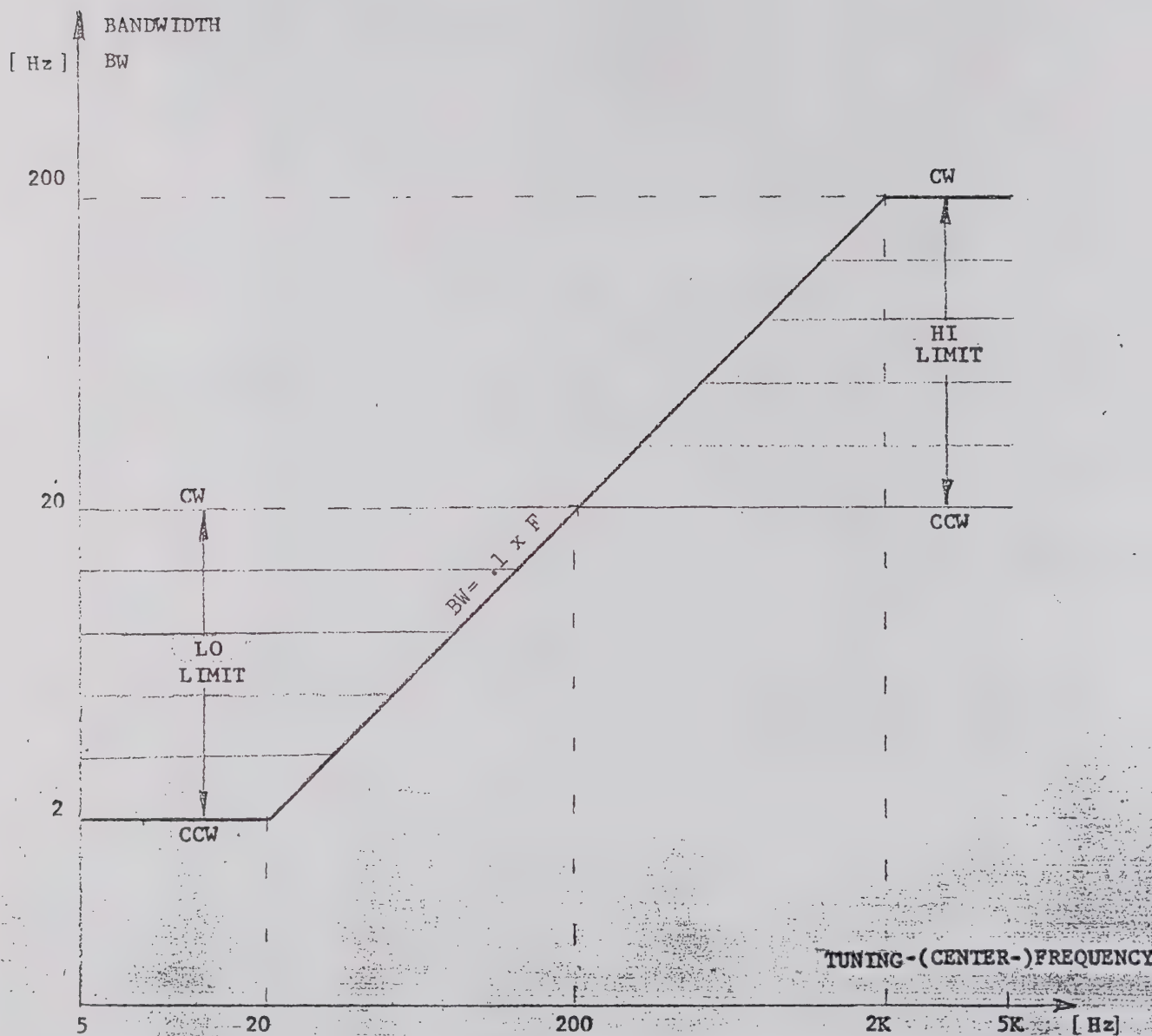
Solution: Use TF22-L (internal LIN DC generator).

- 4.6.4 SD114A - No precaution necessary.



TYP. INTERCONNECTION THROUGH AUX CONTROL CONN.

FIG 4.1



BANDWIDTH VS. TUNING-(CENTER-)FREQUENCY IN THE
AUTO BANDWIDTH MODE

FIG. 4-2

- 4.6.5 B & K Auto Vibration Exciter Controls - Models 1016, 1018, 1019, 1008, 1025 - These instruments do not have a LIN DC vs. FREQUENCY Output. Also some models do not have a constant level output for use as TUNING Signal.

Solution: Be sure the B & K Controller has either internal constant level signal or external "COLA" unit (SD Model SD-11), and use TF22-L.

- 4.6.6 Others - Most other sine generators require the use of TF22-L. Also be sure a constant amplitude tuning signal .3V - 3V RMS is available.

4.7 Operation In A Typical System

- 4.7.1 Be sure tuning generator and TF22 are range compatible (See Section 4.6)
- 4.7.2 Apply power and let system warm up for at least 10 to 15 minutes.
- 4.7.3 Set TUNING Generator approximately to center of desired frequency range.
- 4.7.4 Push 1000 g RANGE and adjust ZERO pots for minimum feed through of tuning signal (typical 2 mV rms or .3 g)
- 4.7.5 Push RANGE switch to max. expected acceleration. The TF22 has approx. 65 to 70 dB dynamic range when properly zeroed. Since many constant displacement tests require input variations of 45 dB it is important to select a range as close to the max accel. as possible to conserve usable range.
- 4.7.6 Set Bandwidth LIMIT pots (see Sec. 4.5 and 4.8). Normally LO LIMIT pot is set fully CCW, HI LIMIT pot fully CW. After adjustment push AUTO.
- 4.7.7 Due to extreme noise signals (rattles in specimen or harmonic resonances) shutdown of Servo (SPA-7) may occur due to overdriving the TF22. In that case select nearest high acceleration range on TF22.

4.8 DISPLACEMENT Mode

When using the TF22 over a larger dynamic range in the servo loop of a shaker system (such as constant displacement over a large frequency range), it may be desirable to bypass the filter as the signal approaches the noise floor. A Rear Panel switch (see Fig. 3.1) selects a mode in which the TF22

4.8 (cont'd)

goes into BYPASS when the tuning frequency goes below the LO LIMIT frequency. This mode is only active when the BANDWIDTH switch is at AUTO and the RANGE switch is at 100, 300 or 1000 g. (When used with D22-T, see also Section 4.9.)

4.9 Operation With D22-T Charge Amplifier (See Fig. 4.1)

When using the TF22 with the Model D22-T Charge Amplifier (with tracking filter option) the ranges are shifted, since the signal from the D22 "TF" OUTPUT is not 10 mV/g, as it is from the "SERVO" OUTPUT. The used RANGE switch positions are as follows, and are noted on the left side of the front panel near the appropriate pushbuttons:

<u>D22 RANGE</u>	<u>USE TF22 RANGE</u>	
1	10	
3	30	
10	100	Set DISP switch in N position.
30	300	
100	300	
300	300	
1k	300	

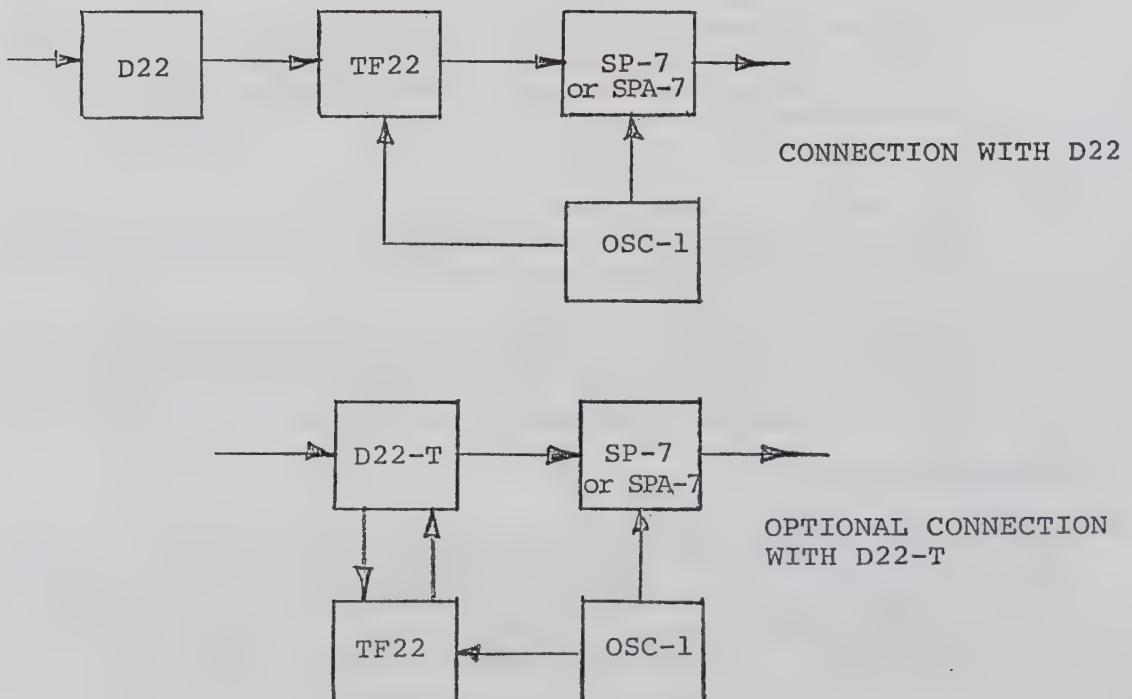


Fig. 4-3 Operation with D22-T

5. THEORY OF OPERATION AND CIRCUIT DESCRIPTION

A block diagram of the TF22 can be found in Fig. 5.1. Fig. 8.1 shows a detailed block diagram, and the circuitry of the individual PC boards is shown in Section 8.

5.1 Theory of Operation

For the purpose of description, it is assumed that the tuning frequency is 500 Hz ($\sin \omega t$) and the input signal contains a 500 Hz component of amplitude A and phase ϕ relative to the tuning signal $[A \sin (\omega t + \phi)]$ plus a distortion signal at 1000 Hz ($B \sin 2 \omega t$). A COSINE tuning signal ($\cos \omega t$) is generated in the TF22.

In the CO-demodulator the input signal is demodulated by the SINE tuning signal and the output contains several components:

Zero Hz component	$A \cos (\phi)$
1000 Hz component	$A \cos (2 \omega t + \phi)$
500 Hz component	$B \cos (\omega t)$
1500 Hz component	$B \cos (3 \omega t)$

In the following filter all AC components are filtered out, and only the $A \cos \phi$ component remains. Conversely, the filtered output of the QUAD-demodulator is $A \sin \phi$.

In the modulators the DC signals are modulated again by the SINE and COSINE signal. The outputs are $A \cos \phi \sin \omega t$ and $A \sin \phi \cos \omega t$, the vector sum of which is $A \sin (\omega t + \phi)$, the 500 Hz component of the input signal.

5.2 Circuit Description

5.2.1 The Auto Gain and Phase Control (Board A) generates the SINE and COSINE for the CO and QUAD modulators (multipliers).

The TUNING signal, which may vary from .3 to 3V rms is amplified to 5V rms in Z1 (BoardA). A meter-integrator circuit controls the variable resistor V1 to stabilize the output voltage.

The SINE signal is phase rotated in the variable ALL-PASS, which rotates the phase vector of the SINE signal through the first and second quadrant depending upon frequency and value of V2. Z3 is a phase comparator. The average of the output signal at TP-2 is 0V when the phasors of the two inputs (SINE and COSINE) are 90° apart. The error signal is integrated and fed back to V2, the control element of the ALL-PASS.

- 5.2.2 The I/O Buffer and Log DC (Board B) contains amplifiers to buffer the normalized (attenuator) input signal and the restored (unity gain) output signal. A peak detector detects when the input signal exceeds the dynamic range of the TF22 Tracking Filter.

Z3, Z4 and Z5 comprise a log converter circuit which is connected to the LOG DC output.

- 5.2.3 Each of the Modulator Boards (DC and DQ) contain two multipliers connected as double balanced modulators.

The first modulator demodulates the input signal by multiplying the input signal by the reference SINE (COSINE) signal. The DC component of the signal at the output (pin K) is proportional to the CO (QUAD) component of the input signal. After filtering out all AC components in the LO-PASS filter the DC component is multiplied (modulated) by the reference SINE (COSINE) signal. The resulting CO (QUAD) signal is added to the QUAD (CO) signal of the other channel on the DC Board. The corresponding amplifier on the DQ Board removes the DC component of the filtered signal.

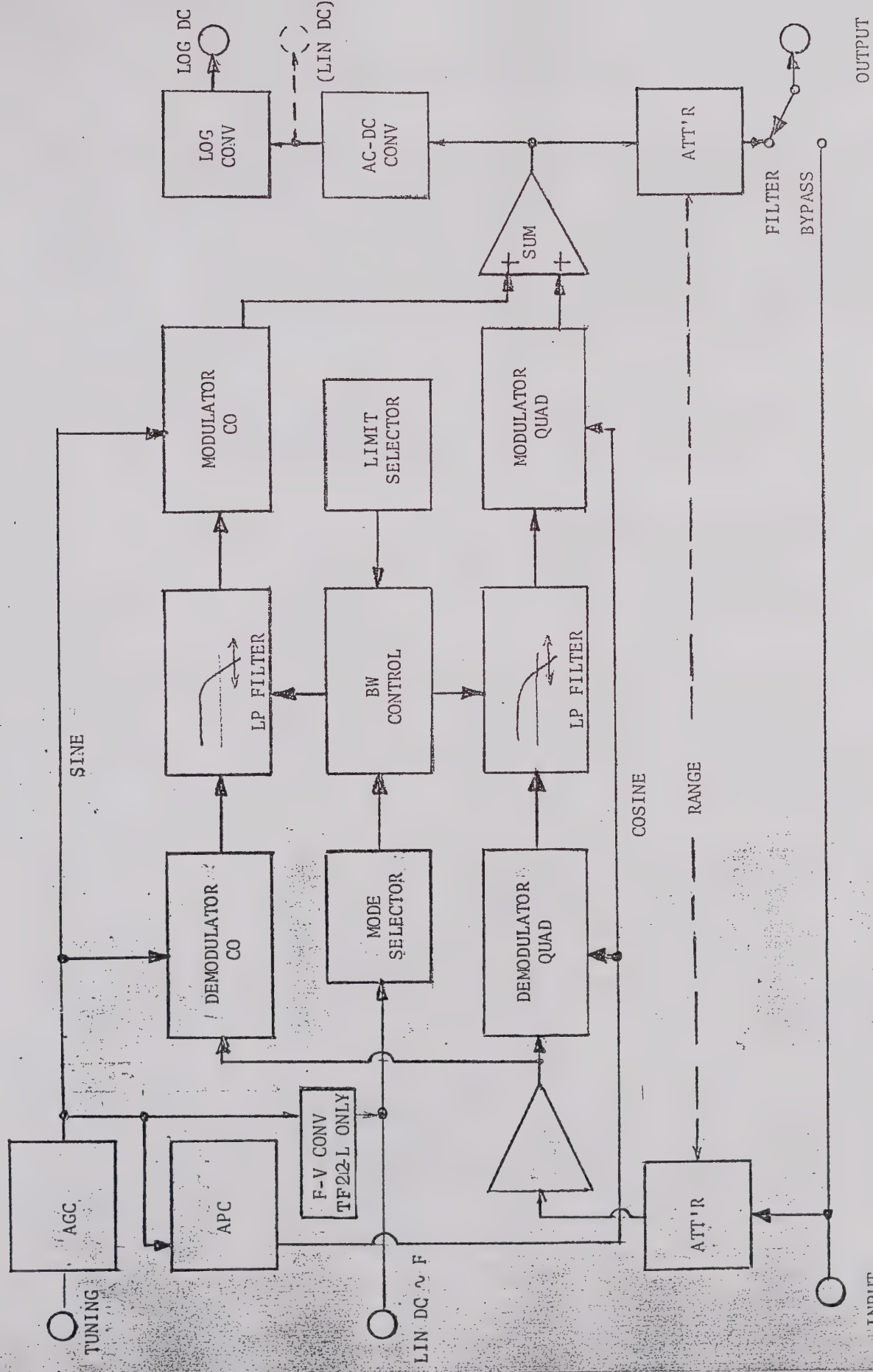
- 5.2.4 The Filter (Board F) is a dual channel voltage controlled LO-PASS.

The controlling signal is the LIN DC vs FREQUENCY signal from the TUNING generator (OSC-1). Two sections of Z1 limit this DC signal to the range set by the HI LIMIT and LO LIMIT controls. The EVRs (electrically variable resistors) are selected to track within 6 dB and the desired characteristic of resistance inversely proportional to frequency is obtained by placing one EVR (V1) in a feedback circuit.

The two filter sections have approximately three-pole Butterworth transfer function.

- 5.2.5 The optional (TF22-L only) LIN DC Connector (Board L) is a Frequency to Voltage converter.

The Sine reference signal is amplified proportional to frequency in a differentiating amplifier and then rectified in the following full-wave rectifier.



BLOCK DIAGRAM TF22

FIG. 5.1

6. MAINTENANCE & CALIBRATION

The instrument has been adjusted and calibrated at the factory and under normal conditions no readjustments except for front-panel ZERO adjustments are necessary. However, if prolonged use, customer calibration procedures, or major replacement of components make adjustments necessary, the procedure outlined in Section 6.1 through 6.6 with the instrument covers on should be followed. Remove the covers for further checking and adjustment only if malfunction or out-of-tolerance performance is suspected. ALLOW THE INSTRUMENT TO WARM UP AT LEAST 15 MINUTES BEFORE ATTEMPTING CHECKOUT OR CALIBRATION.

6.1 Instruments and Connections

Refer to the Table 6.1 below for instruments and to Table 6.2 for instrument connections.

DESCRIPTION	TYP. MODEL	USE
Sine Generator - 5 Hz to 5 kHz .3V to 3V rms Linear DC vs Frequency Output	U-D OSC-1	TUNING Generator
Sine Generator - 5 Hz to 5 kHz 5 mV to 5V rms variable	U-D OSC-1 (#2) HP Model 204D	SIGNAL Generator
AC Voltmeter Oscilloscope	HP Model 400EL HP Model 1202B	Monitor Signal Amplitudes And Waveshapes
DC Monitor	HP Model 7035B (plotter) Keithley Mod 168 (Auto DVM)	Measure LOG DC Output
Ratio Transformer (Optional)	Singer RT-20R	Varies signal precisely with- out changing oscillator in- put

TABLE 6.1 INSTRUMENTS

FROM	TO
TUNING gen. (AC out)	X AXIS Oscilloscope TF22 TUNING input
TUNING gen. (lin DC vs freq)	TF22 LIN DC input (not req'd for TF-11L)
SIGNAL gen. (AC out)	TF22 INPUT
AC voltmeter	Oscilloscope Y-AXIS
Oscilloscope Y AXIS	Point Monitored
DC Monitor	TF22 LOG DC output

TABLE 6.2 CONNECTIONS

The optional ratio transformer can be used between the SIGNAL generator and the TF22 input to provide a precisely set AC voltage without having to continually change the SIGNAL generator output.

6.2 OUTPUT ZERO (covers on)

Provide: SIGNAL input - zero (signal source connected or input shorted)
 TUNING input - 500 Hz $\approx$ 1V rms
 F.S. RANGE - 300g

Monitor: OUTPUT

Adjust front-panel ZERO potentiometers for minimum output. Refer to Fig. 6.1 for proper adjustment. If ZERO adjustment cannot be made from front panel, refer to Section 6.7.

6.3 OUTPUT ENVELOPE (covers on)

Provide: SIGNAL input - 502 Hz, 1.00 V rms
 TUNING input - 500 Hz, $\approx$ 1 V rms
 300 g range; HI-LIMIT bandwidth (CW)

Monitor: TF22 output

Average output should be 1.00 V $\pm$ 1% and variation of gain as Lisajous pattern rolls over and over should be within $\pm$ 1.5%. Refer to Fig. 6.2 for typical output patterns and corrective adjustments if any.

Decreasing F.S. RANGE to 100g should cause OVERLOAD indicator to flash.

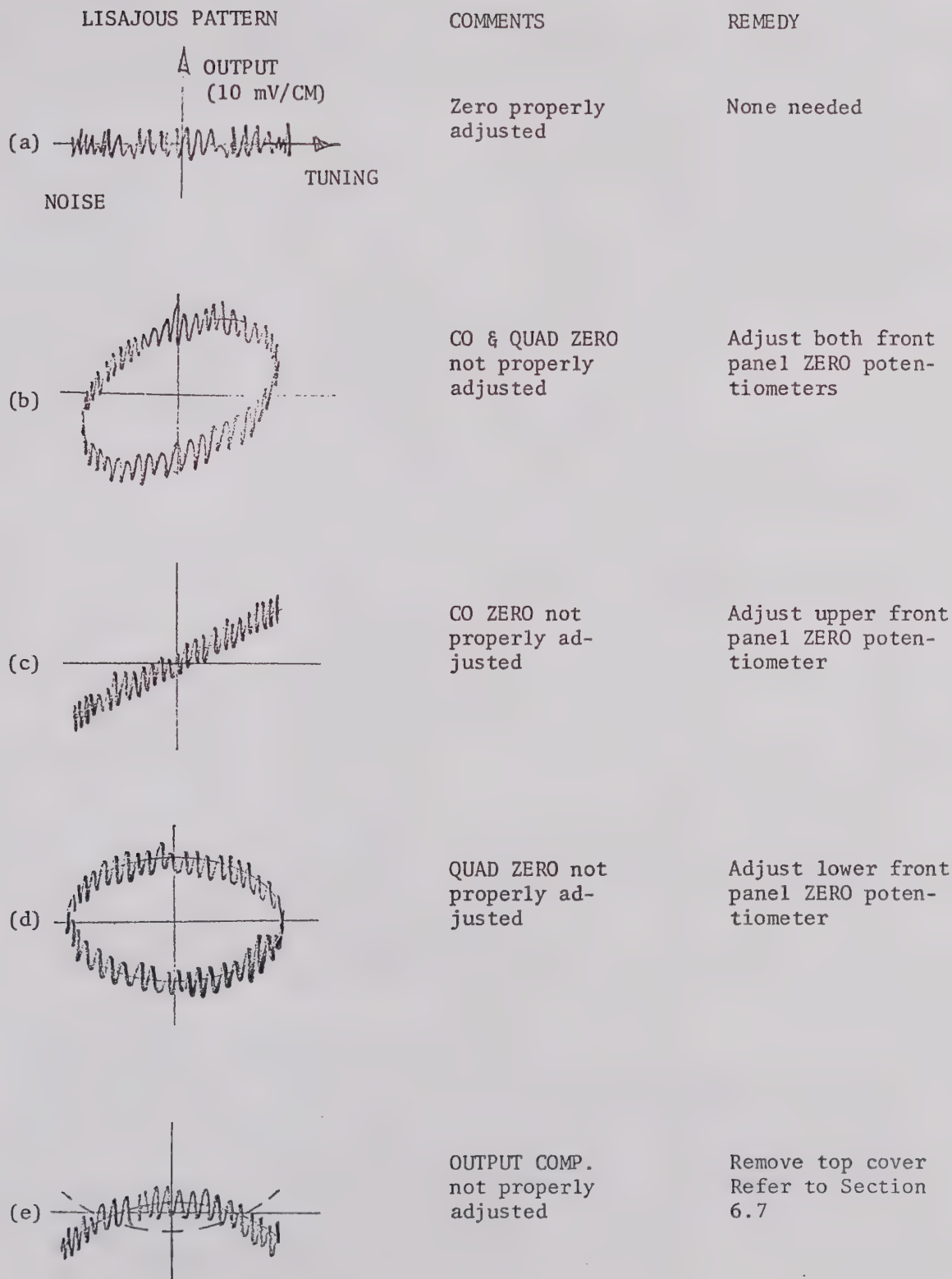
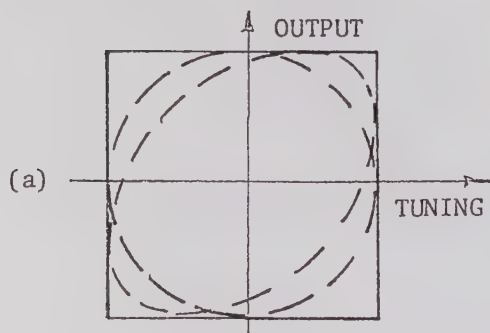


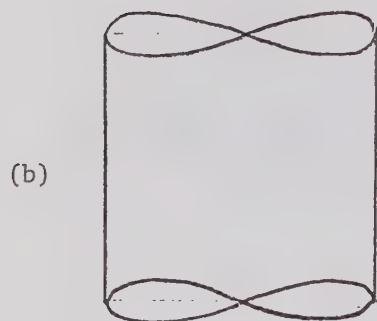
FIG. 6.1

OUTPUT ZERO ADJUSTMENT LISAJOUS PATTERNS
ZERO SIGNAL INPUT - 300g F.S. RANGE



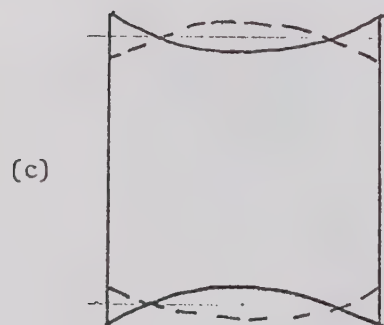
Output properly
adjusted
Av. gain = $1.0 \pm 1\%$
Gain $\Delta < \pm 1.5\%$

None needed



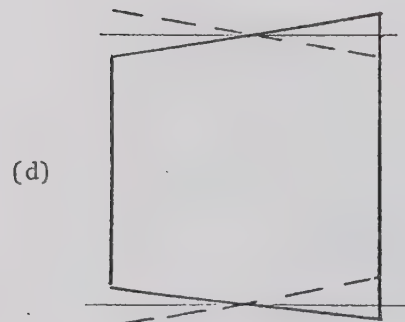
Phase not cor-
rectly adjusted.
Gain variation
with phase noted
in 6.3.

Adjust PHASE
through top
cover to min-
imize gain
variation



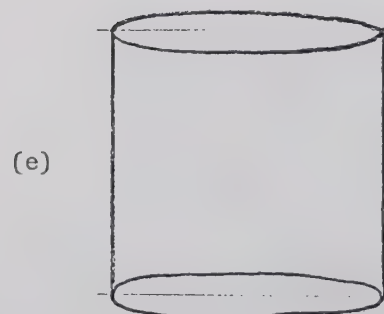
Gain Balance not
correctly adjusted.
Gain variation with
phase noted in 6.3.

Adjust GAIN BAL-
ANCE through top
cover to minimize
gain variation.
Adjust GAIN to re-
establish unity
gain.



CO Flatness not
correctly adjusted.
Does not cause
gain variation with
phase

Remove top cover.
Refer to Fig. 6.3.
Adjust FLATNESS on
D-C Card.



QUAD Flatness not
correctly adjusted.
Does not cause gain
variation with phase.
Should gain varia-
tion be noticed,
check ZERO (section
6.2)

Remove top cover.
Refer to Fig. 6.3.
Adjust FLATNESS on
D-Q Card.

FIG. 6.2 OUTPUT ENVELOPE LISAJOUS PATTERNS

Should average output fall outside $1.00\text{V} \pm 1\%$, readjust GAIN through top cover. Should GAIN adjustment through top cover be inadequate, refer to Section 6.10.

Failure to provide a rectangular output modulation envelope as in Fig. 6.2 (a), but one that pulses or looks like a "bow tie" indicates that either the CO or the QUAD modulator card (D-C or D-Q) may be faulty. Proceed to Section 6.13.

Excessive phase error patterns, even at very small frequency differences, indicates a problem on the FILTER CARD F. Proceed to Sections 6.11, 6.12 and 6.13.

6.4 FREQUENCY RESPONSE (covers on)

Provide: SIGNAL input - 1.00 V rms
 TUNING input - $\sim 1\text{ V rms}$
 HI LIMIT (where requested) - CW (200 Hz)
 LO LIMIT (where requested) - CCW (2 Hz)
 F.S. RANGE - 300 g

TUNING (Hz)	SIGNAL (Hz)	AVERAGE OUTPUT (rms)	GAIN VARIATION	BANDWIDTH
5000	5002 - 5005	$1.00\text{ V} \pm 2\%$	$\pm 2.5\%$	HI-LIMIT
50	50.1 - 50.2	$1.00\text{ V} \pm 1\%$	$\pm 1.5\%$	LO-LIMIT
5	5.1 - 5.2	$1.00\text{ V} \pm 2\%$	$\pm 2.5\%$	LO-LIMIT

The small differences in SIGNAL frequency and TUNING frequency that are required can be obtained by varying one or the other until the Lisajous pattern rolls over and over at the approximately required difference frequency.

Should excessive gain variation with phase occur at the extremes of the frequency band refer to Sections 6.11 and 6.12.

6.5 FILTER BANDWIDTH (covers on)

Provide: SIGNAL input - 600 Hz 1.00 V rms
 TUNING input - 500 Hz $\approx 1\text{ V rms}$
 F.S. RANGE - 300 g
 HI-LIMIT - CW (200 Hz)

Monitor: OUTPUT

The measured value of output should be approximately 0.6 - 0.8 V rms. The modulation envelope may be slightly distorted, as in Fig. 6.2 (b) and (c). This is acceptable, as it is impossible to match the filter skirts of the CO and QUAD channels exactly with EVR's.

Provide: SIGNAL input 51.0 Hz 1 V rms
TUNING input 50.0 Hz ~ 1 V rms
300 g F.S.
LO-LIMIT BW CCW - (2 Hz)

Monitor: OUTPUT on Y Axis (TUNING on X-Axis)

The measured average value of the output should again be 0.6 to 0.8 V rms and some distortion on the modulation envelope is acceptable. Should the measured average value be out of tolerance, consult 6.19.

If replacement of EVR(s) is needed, a matched set must be supplied for Card F, although a single failed EVR may often be replaced by changing the EVR's around in the circuit, and performing the checks above.

6.6 LOG DC (covers on)

Provide: Check ZERO balance
SIGNAL input - variable voltage at 505 Hz
TUNING input - ~ 1 V rms 500 Hz
HI-LIMIT CW (200 Hz BW)
F.S. RANGE to 300 g.

Monitor: LOG DC output with digital DCVM.
SIGNAL output, TUNING input (Lisajous pattern)

The following values of LOG DC output should be noted as a function of input voltage.

INPUT mV rms	2240	707	224	70.7	22.4	7.07
LOG DC V DC	0.000	-.500	-1.000	-1.500	-2.000	-2.500
TOLERANCE mV DC	±13	±13	±13	±13	±13	±50

Should any of the readings be out of tolerance, remove the top cover and refer to Section 6.16.

The following sections are used only to pinpoint malfunctions or to correct for out-of-tolerance performance. The adjustments are made at the factory and normally do not have to be done again. Remove the covers before proceeding and refer to Fig. 6.3 for the location of various adjustments and circuit boards. THE FOLLOWING SECTIONS ARE NOT PART OF THE NORMAL CALIBRATION PROCEDURE.

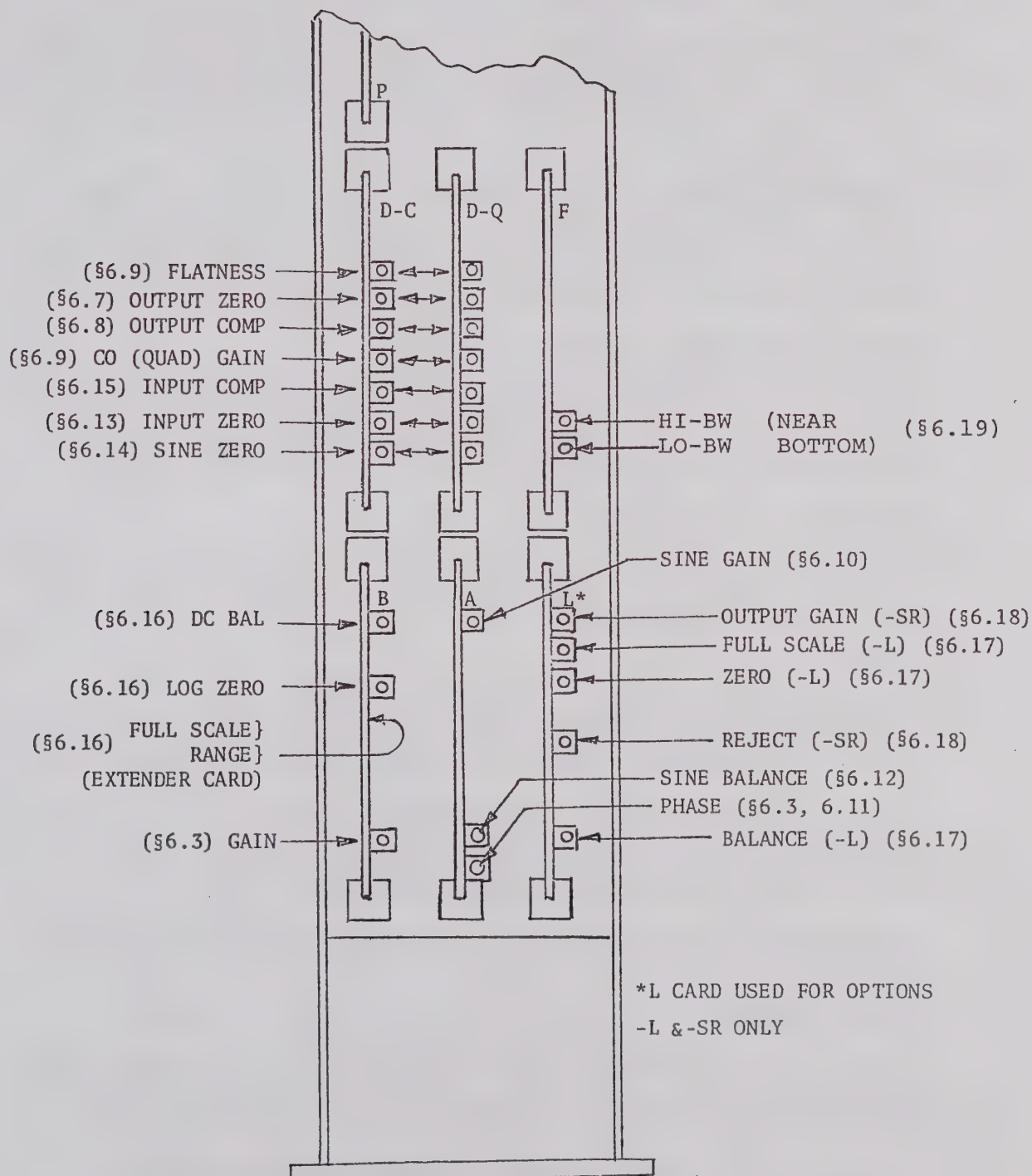


FIG. 6.3

TOP VIEW OF TF22 WITH COVER REMOVED
ADJUSTMENT LOCATIONS SHOWN
AND SECTION REFERENCES

6.7 OUTPUT ZERO (Cards D-C and D-Q)

Should adjustment be impossible to make from the front panel, turn both front panel pots full CCW and then turn both ten turns CW. With the same setup as in Section 6.2 adjust the OUTPUT ZERO potentiometers on the D-C and D-Q cards for minimum output.

Should the OUTPUT ZERO adjustment be particularly unstable or the internal potentiometer adjustment is insufficient, check to see that the heaters are working on the multipliers mounted on the D-C and D-Q cards under the sponge insulators. Consult factory if the trouble is not apparent.

6.8 OUTPUT COMPENSATION (Cards D-C and C-Q)

With the conditions the same as in 6.2, excessive curvature in the ZERO output Lisajous pattern (second harmonic output) as in Figure 6.1 (e) requires correction by adjusting the OUTPUT COMP. potentiometer on either the D-C or D-Q card.

6.9 FLATNESS, GAIN BALANCE (Cards D-C & D-Q)

Refer to Fig. 6.2 and Section 6.3 for test conditions. Either CO or the QUAD GAIN potentiometer may be used to adjust the GAIN BALANCE needed in Fig. 6.2 (c).

6.10 SINE GAIN (Card A)

If the GAIN adjustment in Section 6.3 is insufficient to establish unity gain, set GAIN potentiometer (Card B) to middle range and adjust SINE GAIN for unity gain as in Section 6.3.

Monitor voltage at TP-1 (see Component Layout Card A). The value is not critical, but should generally be 5V rms $\pm 10\%$. The value should be constant as the TUNING input is varied from .3 to 3V rms after AGC action has occurred.

Adjustment of the SINE GAIN may require readjustment of the SINE BALANCE in Section 6.12.

6.11 PHASE (Card A)

Perform the following if excessive gain variation with phase occurs at 5 Hz or 5 kHz after the PHASE adjustment has been properly made at 500 Hz as described in Section 6.3 and Fig. 6.2 (b).

Monitor TUNING or TP-1 on X-Axis
TP-3 on Y-Axis

Switch tuning frequency successively from 5 to 50 to 500 and finally to 5000 Hz. The amplitude at TP-3 should remain at 5V rms $\pm 10\%$ and the Lisajous pattern should show the circle typical of 90° phase at each frequency after the APC takes a fraction of a second to correct after each frequency switching.

If 90° phase cannot be maintained at all frequencies, proceed to 6.12, but do not readjust the PHASE potentiometer.

6.12 SINE BALANCE (Card A)

Monitor: TUNING on X-Axis
TP-2 on Y-Axis

Switch TUNING frequency successively from 5 to 50 to 500 to 5000 Hz. The proper shape of the Lisajous pattern is shown in Fig. 6.4 after APC correction.

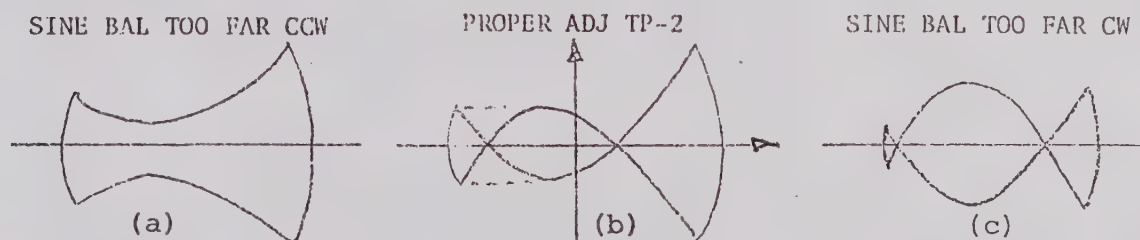


FIG. 6.4 BALANCE OF PHASE DETECTOR-LISAJOUS PATTERNS

A little rounding of the sharp corners of the pattern is to be expected at 5 kHz. Adjust SINE BALANCE for the equal lobes as shown in Fig. 6.4 (b). Readjust PHASE as in Section 6.3.

If 90° phase cannot be maintained in 6.11 and 6.12, replacement of V2 (light-controlled resistor) may be attempted as a solution. A factory-supplied low-distortion unit is necessary here.

6.13 INPUT ZERO (Cards D-C & D-Q)

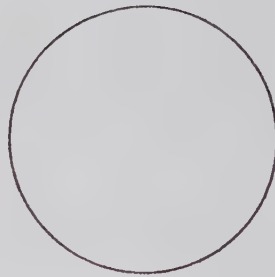
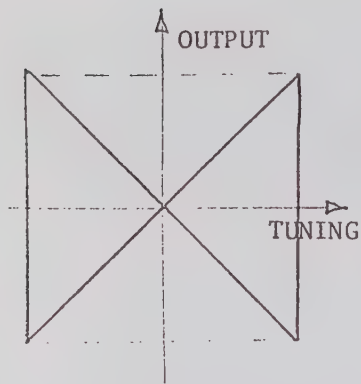
Provide: Zero SIGNAL input
TUNING signal - 500 Hz 1V rms

Monitor: TP-C (Card F)

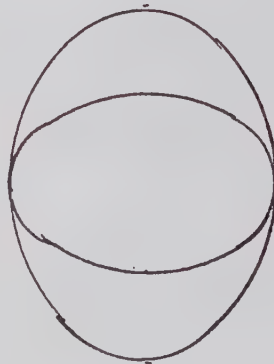
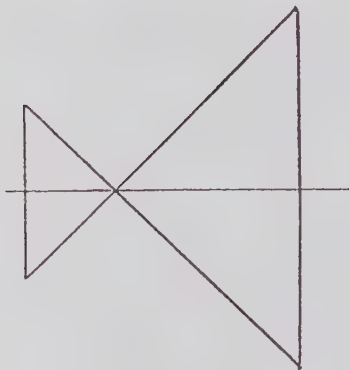
Adjust INPUT ZERO (Card D-C) for minimum first harmonic signal

Monitor: TP-Q (Card F)

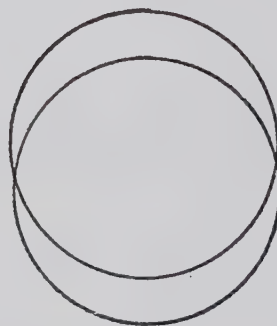
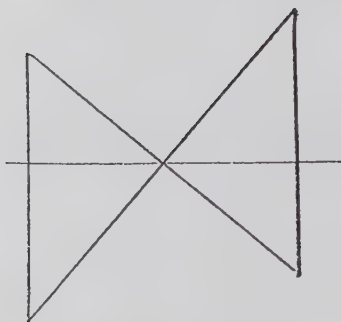
Adjust INPUT ZERO (CARD D-Q) for minimum first harmonic signal. Refer to FIG. 6.5 for proper modulation envelope with SIGNAL input = 1.00V rms (300g range) 505 Hz.



Properly Adjusted
Equal Lobes



SINE ZERO improperly
adjusted. See sec-
tion 6.



INPUT ZERO improperly
adjusted. See sec-
tion 6.12.

FIG. 6.5

LISAJOUS PATTERNS
MODULATOR OUTPUT ENVELOPES

If proper signal pattern is absent, replace multiplier Z2 on appropriate card.

6.14 SINE ZERO (Cards D-C & D-Q)

Provide: SIGNAL input - 505 Hz 1V rms
TUNING input - 500 Hz $\sim$ 1V rms
300g F.S. RANGE

Monitor: TP-C and TP-Q (Card F)

Refer to Fig. 6.5 and adjust SINE ZERO on TP-C and TP-Q to establish equal lobes on modulation envelope.

Any readjustment in Sections 6.13 and 6.14 requires a re-examination of the OUTPUT envelope as in Section 6.3.

6.15 INPUT COMPENSATION (Cards D-C & D-Q)

Provide: SIGNAL input - .707 V rms, 200 Hz
TUNING input - 1 V rms, 500 Hz
LO-LIMIT - CCW (2 Hz BW)
F.S. RANGE - 100g

Monitor: OUTPUT (Y axis), TUNING input (X axis)

Make sure the ZERO adjustment has been accurately done. Alternately remove and apply the SIGNAL input and adjust INPUT COMP on D-C and D-Q cards until no change is seen on the Lisajous pattern. (Use Y axis sensitivity of 5 mV/cm).

If a Lisajous pattern like Fig. 6.1 (a) cannot be obtained with the above adjustment but a pattern like 6.1 (c) or (d) is obtained, remove the appropriate card (D-C or D-Q). Then change the resistor RI to the alternate location (See Fig. 8.7) Then repeat the adjustment procedure.

The INPUT COMPENSATION adjustment affects the GAIN BALANCE, so it is generally required to repeat 6.9.

6.16 LOG DC (Card B)

Use setup described in 6.6. With zero SIGNAL input, monitor TP-2 (Card B) with the oscilloscope, and DCVM. Adjust DC BAL (Card B) until 0V $\pm$ 50 mV DC is obtained.

Then monitor LOG DC output with the digital DCVM.

Then make the adjustments in the following table for the corresponding input voltages

	Step	1	2	3
For SIGNAL input (mV rms)		2240	70.7	7.07
Adjust on Card B		FULL SCALE	RANGE	LOG ZERO
To give LOG DC (V DC)		0.000	-1.500	-2.500

Repeat Steps 1, 2, and 3 if necessary, and recheck data required in 6.6. An extender card may be required.

6.17 LIN DC GENERATOR (Card L - L Option only)

Monitor and make adjustments in Table below.

TUNING freq (Hz)	MONITOR	ADJUST Potentiometer	MEASURE
20	TP-1 Card L	BAL	equal half sine waves
2,000 Hz	LIN-DC out	FULL SCALE	4 V DC
20	LIN-DC out	ZERO	40 mV DC

6.18 SINE REJECT (Card L - SR Option only)

Provide: TUNING input - 500 Hz 1 V rms
 SIGNAL input - 550 Hz 1 V rms
 BW to LO LIMIT (CCW - 2 Hz)

Monitor: SINE REJECT output

Adjust: OUTPUT GAIN pot (Card L) for unity gain (out-of-band signal)

Then put BW to HI-LIMIT (CW-200 Hz), SIGNAL input to 500.5 Hz ($\Delta f \approx .5$ Hz.)

Adjust: REJECT pot. (Card L) for minimum output (in band signal).

6.19 FILTER BANDWIDTH Adjustment (Card F)

Remove top cover. Provide conditions for HI-LIMIT bandwidth measurement in 6.5. Check the DC voltage at TP-1 (Card F). It should be $4.0 \pm .4$ V DC. Then adjust HI-BW so that OUTPUT voltage as measured in 6.5 is 0.7 V rms.

Then provide the conditions for LO-LIMIT bandwidth measurement in 6.5. Note that the SIGNAL and TUNING frequency difference must be exactly 1.0 Hz. Check the DC voltage at TP-1. It should be 40 ± 4 mV DC. Then adjust LO-BW so that OUTPUT voltage as measured in 6.5 is 0.7 V rms.

7. REPLACEMENT PARTS

7.1 General

Whenever possible standard electronic components have been used in this instrument. Most standard components can be purchased locally. Difficult to find components and special components are listed in Section 7.2; however, common components such as carbon composition resistors (10%) carbon film resistors (1%), and most capacitors are not called out in this replacement parts list. When ordering replacement parts or subassemblies from Unholtz-Dickie Corporation, please always include:

- a) complete description of item ordered
- b) schematic reference number, if assigned
- c) description of assembly in which part is used
- d) model and serial number of instrument

Alternate Parts may be substituted in some cases where availability and pricing warrant. In particular in the case of semiconductors several manufacturers may make almost identical items or identical items under different part numbers. Section 7.3 lists some of the alternate parts that may be found in a particular instrument.

7.2 Replacement Parts List

7.2.1 Chassis Assembly

FRONT PANEL MOUNTED PARTS

SOURCE	PART NO	DESCRIPTION	QTY
U-D CORP	3XF104UGR	3 pos. pushbutton switch	1
U-D CORP	7XF104UGR	6 pos. pushbutton switch	1
BOURNS	A3059J-1-103M	25 turn screwdriver potentiometer 10K	4
KINGS	UC79-45	BNC Connector	2
GENERAL	4000-2	LED indicator (Red)	1
ILLUMINATION		LED indicator (Green)	2

BACK PANEL MOUNTED PARTS

SOURCE	PART NO.	DESCRIPTION	QTY
U-D CORP		(line cord)	
CINCH	P-303-LAB	line voltage	1
CINCH	S-303-CCT	(mating connector)	
BUSSMAN	HWA-AF	Fuse Holder	1
BUSSMAN	GMW 1/2	Fuse 1/2A	1
ALCO	MSS-22	DPST Slide Switch	2
KINGS	KC79-35	BNC Connector	5
CANNON	DBC-25S	25 Pin "D" Connector	1
CANNON	DBC-25P	(mating connector)	
SWITCHCRAFT	46256LFR	115/230 V Switch	1

CHASSIS MOUNTED PARTS

U-D CORP	T-79	Transformer	1
P & B	E10-Z4-J1.OK	Relay	2
AMPHENOL	143-022-01-100	PC Connector	6
AMPHENOL	143-018-01-100	PC Connector	1

7.2.2 Plug-in Subassemblies

Card A-TF22 Auto Gain Control

BARNES	831-55022-084	1C Socket 8 pin	2
INDUSTRIAL ELECTRONIC HARDWARE	MPT 6005-1	Transistor socket 5 pin	2
RCA	CA3080	OP-AMP	1
VAC-TECH	VTL2C2	Electrically variable Re- sistor (EVR) (Selected)	2
SYLVANIA	1N914	Diode	4
BECKMAN	89WR10K	Trimmer Pot 10K	2
BECKMAN	89WR50K	Trimmer Pot 200K	1
MOTOROLA	MC1458CP1	Dual Op. Amp	2
RCA	CA3140	MOS Op. Amp	2

CARD B-TF22 BUFFER AND METER

SOURCE	PART NO.	DESCRIPTION	QTY.
BARNES	821-20011-144	IC Socket 14 pin	4
BARNES	831-55022-104	IC Socket 10 pin	1
FAIRCHILD	μ A 747	Dual Op-AMP	4
FAIRCHILD	μ A 726	Dual Heated Transistor	1
MOTOROLA	2N 4001	NPN Transistor	1
SYLVANIA	1N 914	Diode	5
BECKMAN	89 WR200	Trimmer Pot 200 Ω	2
BECKMAN	89 WR10K	Trimmer Pot 10K	2
BECKMAN	89 WR5K	Trimmer Pot 5K	1

CARD D-TF22 MODULATOR

BARNES	821-20011-144	IC Socket 14 pin	1
BARNES	821 - 20011-164	IC Socket 16 pin	2
FAIRCHILD	μ A 747	Dual Op-AMP	1
UNHOLTZ-DICKIE	MC1494L	Multiplier (Selected)	2
BECKMAN	89 WR10K	Trimmer Pot 10K	1
BECKMAN	89 WR20K	Trimmer Pot 20K	4
BECKMAN	89 WR50K	Trimmer Pot 50K	2
U-D	175Q14111	Thermistor (Bonded to MC1494L)	2
U-D	A12031	Thermal Boot	2

CARD F-TF22 FILTER

BARNES	821-20011-144	IC Socket 14 pin	1
IND ELECTR HARDWARE	MPT 6005-1	Transistor Socket 5 pin	7
MOTOROLA	MC 3303P	Quad Op-AMP	1
VAC-TECH	(VTL-2C2)	Set of 7 selected VTL 2C2 Electrically Variable Re- sistor (EVR)	1
MOTOROLA	2N4401	NPN Transistor	2
MOTOROLA	2N4403	PNP Transistor	1
RCA	CA3140	MOS Op-AMP	2
SYLVANIA	1N 914	Diode	3
BECKMAN	89 WR2K	Trimming Pot 2K	1
BECKMAN	89 WR50K	Trimming Pot 50K	1

CARD L-TF22 LIN DC GENERATOR (Optional)

SOURCE	PART NO.	DESCRIPTION	QTY.
BARNES	821-20011-144	IC Socket 14 pin	2
FAIRCHILD	MA 747	Dual OP-AMP	2
SYLVANIA	1N 914	Diode	2
BECKMAN	89 WR10K	Trimmer Pot 10K	3

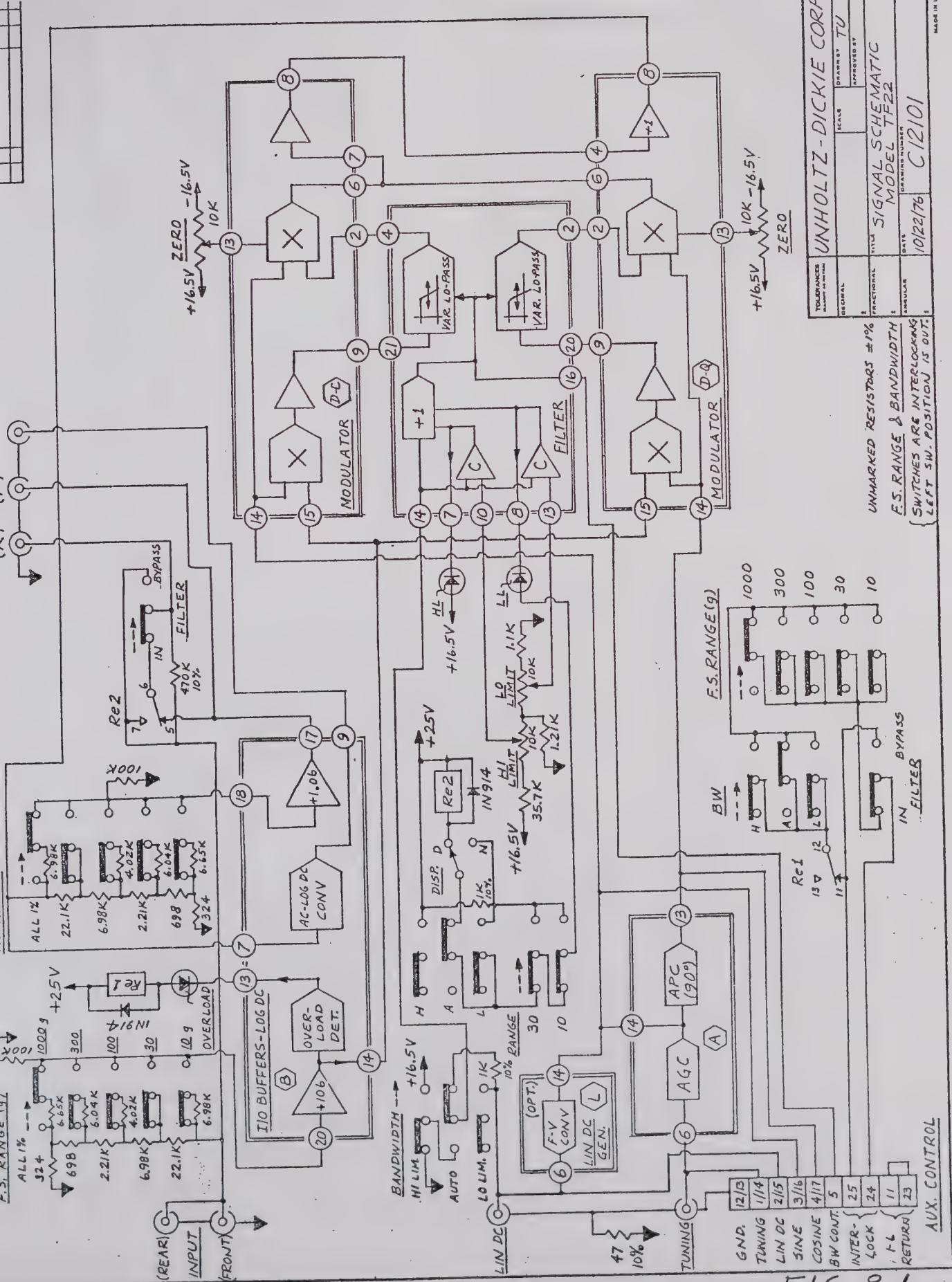
CARD P-TF22 POWER SUPPLY

BARNES	821-20011-144	IC Socket 14 pin	2
FAIRCHILD	μA 723	Power Supply Regulator	2
MOTOROLA	2N 4003	PNP Transistor	1
MOTOROLA	2N 4922	NPN Power Transistor	1
MOTOROLA	2N 4919	PNP Power Transistor	1
WESTINGHOUSE	1N5394	Rectifier Diode 300V	4

The AD540J (Analog Devices) may be substituted for the CA3140 (RCA)

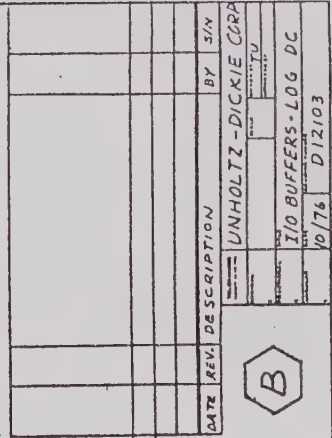
8. SCHEMATICS AND LAYOUT DIAGRAMS

<u>FIG.</u>	<u>TITLE</u>	<u>DWG. NO.</u>	<u>REV.</u>
8.1	Signal Schematic TF22	C12101	NC
8.2	AGC - APC - Schematic Card A	B12085	A
8.3	AGC - APC - Layout Card A	D12114	NC
8.4	I/O Buffers-Log DC - Schematic Card B	B12102	NC
8.5	I/O Buffers-Log DC - Layout Card B	D12103	NC
8.6	Modulator - Schematic Card D	B12104	NC
8.7	Modulator - Layout Card D	D12105	NC
8.8	Filters - Schematic Card F	B12106	NC
8.9	Filters - Layout Card F	D12107	NC
8.10	Power Supply Schematic	B12111	NC
8.11	Power Supply - Layout Card P	B12079	A
8.12	F/V Converter - Schematic Card L	A12112	NC
8.13	F/V Converter - Layout Card L	D12113	NC





MADE IN U.S.A.



* 1% METAL FILM RES.
(OTHERS 10% - 1/4W)

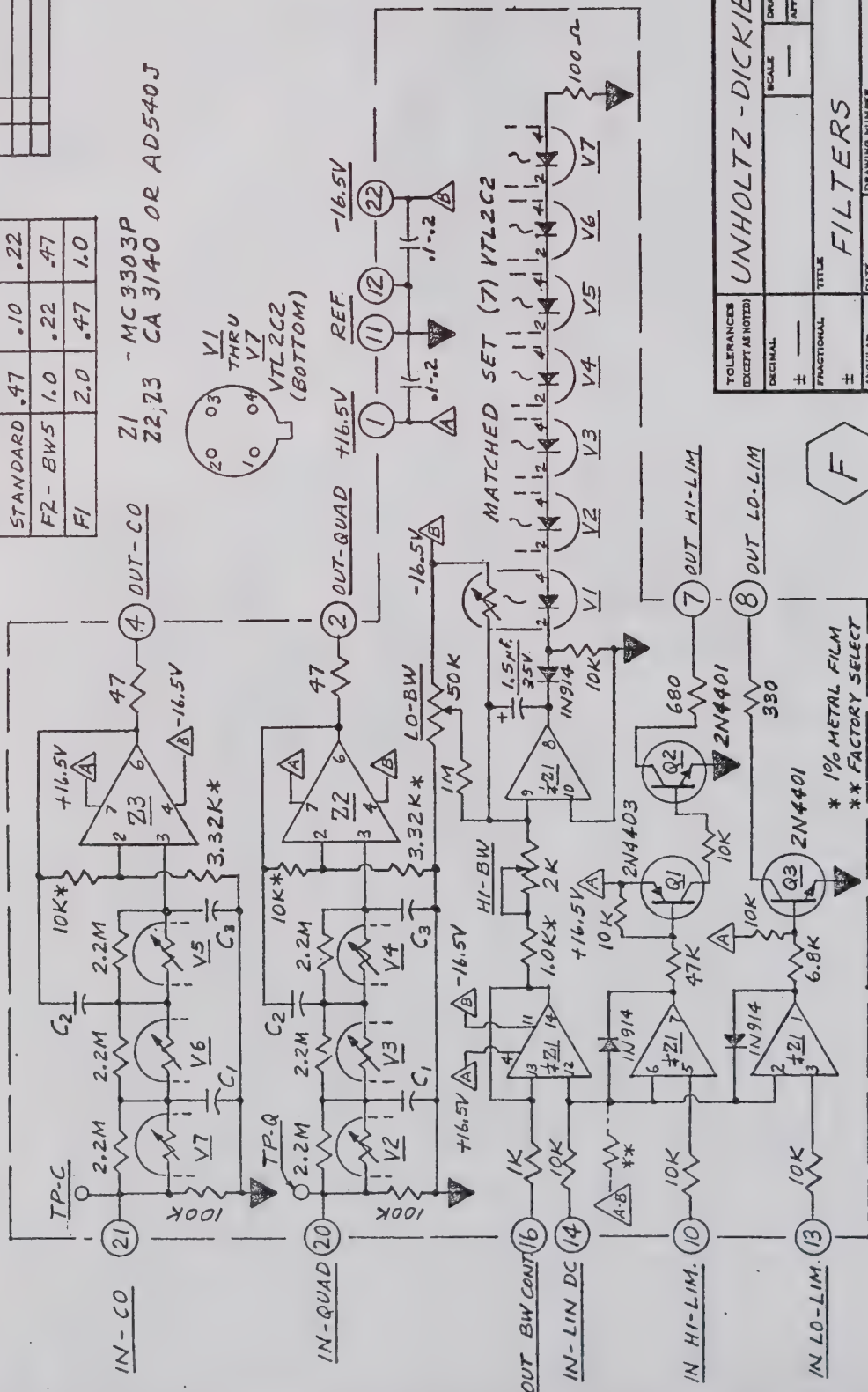
FIG 8.5

DATE	SYM	REVISION RECORD	AUTH	CHK

OPTION	C ₁	C ₂	C ₃
STANDARD	.47	.10	.22
F2 - BW5	1.0	.22	.47
F1	2.0	.47	1.0

Z1 - MC3303P
22,23 CA 3140 OR AD540J

V1 THRU
V7
VTL2C2
(BOTTOM)



F

UNHOLTZ - DICKIE CORP.

TOLERANCES (EXCEPT AS NOTED)	DECIMAL	FRACTIONAL	ANGULAR
±	—	±	±

SCALE

DRAWN BY

APPROVED BY

TU

TITLE

FILTERS

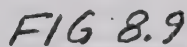
DATE

11-5-76

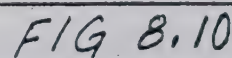
DRAWING NUMBER

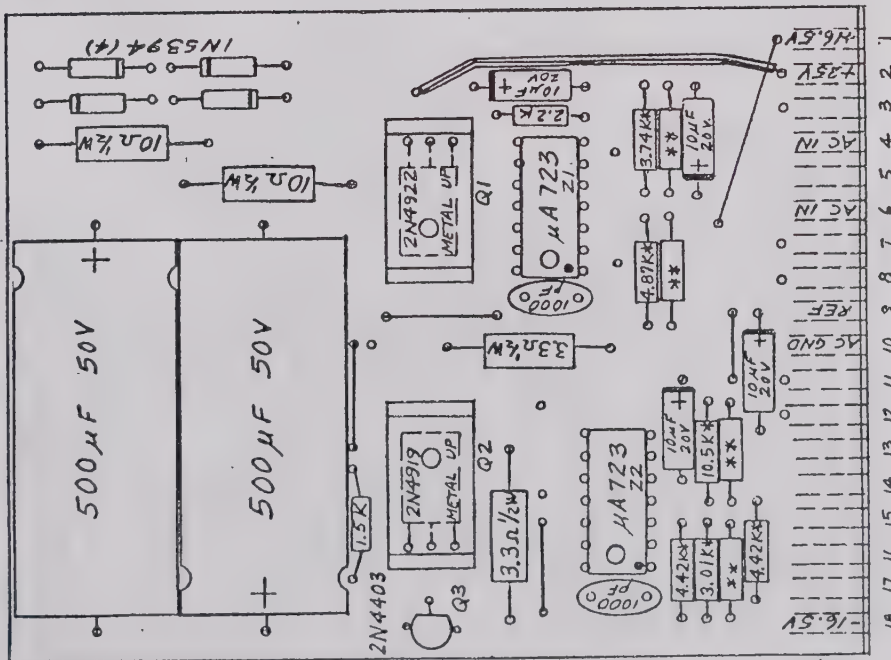
B12106

* 1% METAL FILM RES.
** SET AT FACTORY



DATE	REV	DESCRIPTION	BY	SIX
		UNHOLTZ - DICKIE CORP.		
		LAYOUT		DATE OF TV
		REVISIONS		DATE OF
		10/17/76		DATE OF
		FILTERS		DATE OF
		10/17/76		DATE OF
		10/17/76		DATE OF





P

X- 1% METAL FILM
** FACTORY SELECT

DATE	BY	REVISION RECORD	AUTH	CHK
		REPLACES B12029	TUL	
		A REVISED FOR T722		

TOLERANCES EXCEPT AS NOTED	SCALE	DRAWN BY
DECIMAL	2X	TU
FRACTIONAL		APPROVED BY
ANGULAR		

UNHOLTZ - DICKIE CORP.

COMPONENT LAYOUT
POWER SUPPLY CARD

DRAWING NUMBER
B12079

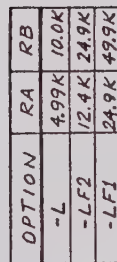
DATE
12-27-74

FIG 8.11

The diagram shows a precision rectifier circuit. The input is labeled "SINE IN" and passes through a resistor R_B and a capacitor $.0033$ to the non-inverting input (pin 1) of an op-amp (pin 7 is ground, pin 10 is V_{CC}). The op-amp is configured with a feedback network consisting of a resistor $10.0K^*$ and a diode. The output of the first stage is connected to a second op-amp (pin 7 is ground, pin 10 is V_{CC}) which is configured as a voltage follower. The output of the second stage is connected to a third op-amp (pin 7 is ground, pin 10 is V_{CC}) which is configured as a precision rectifier. The output of the third stage is connected to a full-scale range of $10.0K^*$. The circuit includes several resistors: $10.0K^*$, $4.99K$, $15.0K^*$, $10K$, $1.0K^*$, and 4.7 . It also includes a capacitor $10\mu F/20V$ and a diode $1N914(2)$. The output is labeled "FULL SCALE" and "ZERO".

OPTION	RA	RB
-L	4.99K	10.0K
-LF2	12.4K	24.9K
-LF1	24.9K	49.9K

FIG 8.12



* - 1% METAL FILM

DATE	REV	DESCRIPTION	BY	S/N
		UNHOLTZ - DICKIE CORP		
			11-10-76	TV
			11-10-76	TV
		FREQUENCY - VOLTAGE CONV.		
			11-6-76	012113



FIG 8.13

UNHOLTZ - DICKIE CORPORATION

Vibration Testing Equipment

3000 WHITNEY AVE.

HAMDEN, CONN. 06518

MAIN OFFICE: HAMDEN, CT
(203) 288-3358

WEST COAST OFFICE: (213) 378-9418
1926 SOUTH PACIFIC COAST HIGHWAY
REDONDO BEACH, CA 90277

WARRANTY

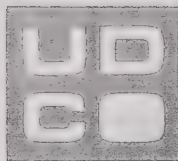
All products are warranted to be free of defects in material and workmanship for a period of one year from date of shipment. If the product is not installed, maintained and used in a normal manner in accordance with instructions and manuals, this warranty will not apply. Commercially available instruments and accessory items purchased and installed in the product will carry the original manufacturer's warranty.

This warranty is limited to repairing or replacing parts which have been returned and in our opinion are defective. Service required to correct defects in material or workmanship will be supplied without charges. The Buyer will pay all transportation and taxes incurred. This warranty does not cover any costs incurred by the Buyer as a result of purchase of UNHOLTZ-DICKIE CORP. equipment or any charges for the Buyer's labor for replacement, adjustment or repair unless authorized in advance in writing. We are not liable for consequential damages.

This warranty will not apply to any products which, in the opinion of UNHOLTZ-DICKIE CORP., have been subject to accident, misuse or neglect; altered or repaired with a substitute which might impair the product; or used outside of rated conditions. UNHOLTZ-DICKIE CORP. reserves the right to make improvements in its products including changes and additions without incurring obligations to incorporate such improvements in previous units.

This warranty is expressly in lieu of any and all other warranties or commitments, expressed or implied and any other obligations to the Buyer associated with the use of UNHOLTZ-DICKIE CORP. products.

**UNHOLTZ-DICKIE
CORPORATION**

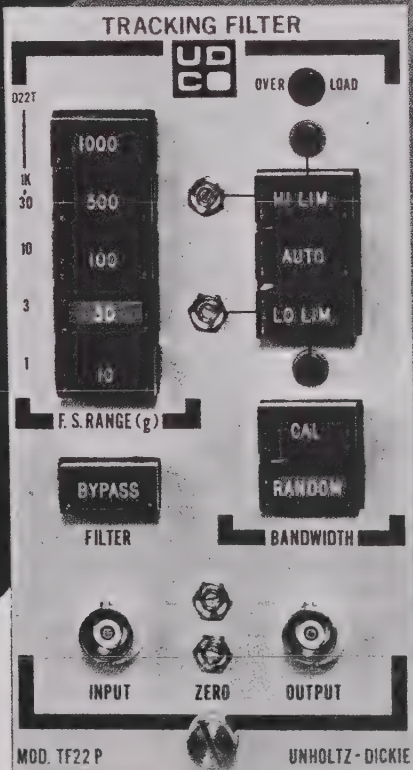
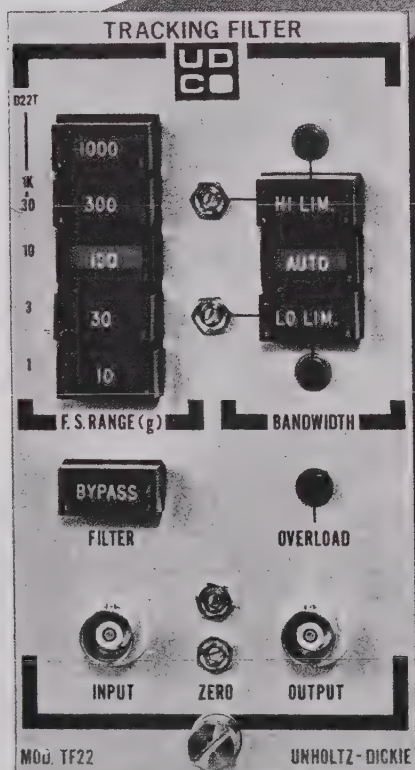


**VIBRATION TEST
EQUIPMENT**

TRACKING FILTERS

All the features of other units at half the price

Standard
**MODEL
TF22**



*Spectral
Analysis*

**MODEL
TF22-P**

OUTSTANDING FEATURES

- Constant percentage bandwidth, or fixed bandwidth - switch selectable
- Dynamic range > 70 dB
- Filtered output at unity gain
- Log converter for filtered signal aids in X-Y plotting
- All integrated circuit design
- Overload indicator and interlock circuits
- Six channels in 5½ x 19" rack

- Interchangeable mounting with D22 Series Signal Conditioners

- Pushbuttons with colored flags

PLUS THESE FOR THE TF22-P:

- Simplified plotting of random test spectrum
- Automatic switching of bandwidth and time constant
- Meets requirements for MIL-STD-810C

APPLICATION AND DESCRIPTION

Any vibration test that requires a tracking filter for one channel should have tracking filters available for all channels. In the past, providing multiple channel tracking filters has been prohibitively expensive for many facilities. However, the TF22 delivers equal or superior performance at half the price and one-sixth the rack space of competitive units.

The TF22 is extensively used to filter noise and harmonic distortion from the control signal in swept-sine vibration tests. It is also extremely useful for mechanical impedance and transfer function analysis. For multiple control point applications where the U-D Model MAC-8 Averager and/or ACS-6 Control Selector are used all acceleration channels can be filtered. With options described below, combined sine/random testing and spectral analysis can be accomplished.

The TF22 is a unity-gain, constant percentage bandwidth tracking filter. The filter bandwidth (BW) varies between 2 and 200 Hz as defined by 10% of the tuning or filter center frequency. The lower BW limit is adjustable from 2 to 20 Hz, and the upper BW limit may be adjusted from 20 to 200 Hz. Fixed BW operation at either limit is also selectable.

The constant percentage BW characteristic is controlled by a DC input which is proportional to center frequency when the AUTO mode is used. The U-D Models OSC-1 Sweep Sine Generator and OSP-4 Oscillator-Servo-Programmer supply this signal, as do some other oscillators. For tuning oscillators not supplying this voltage, an internal F-V converter is available as an option for the TF22.

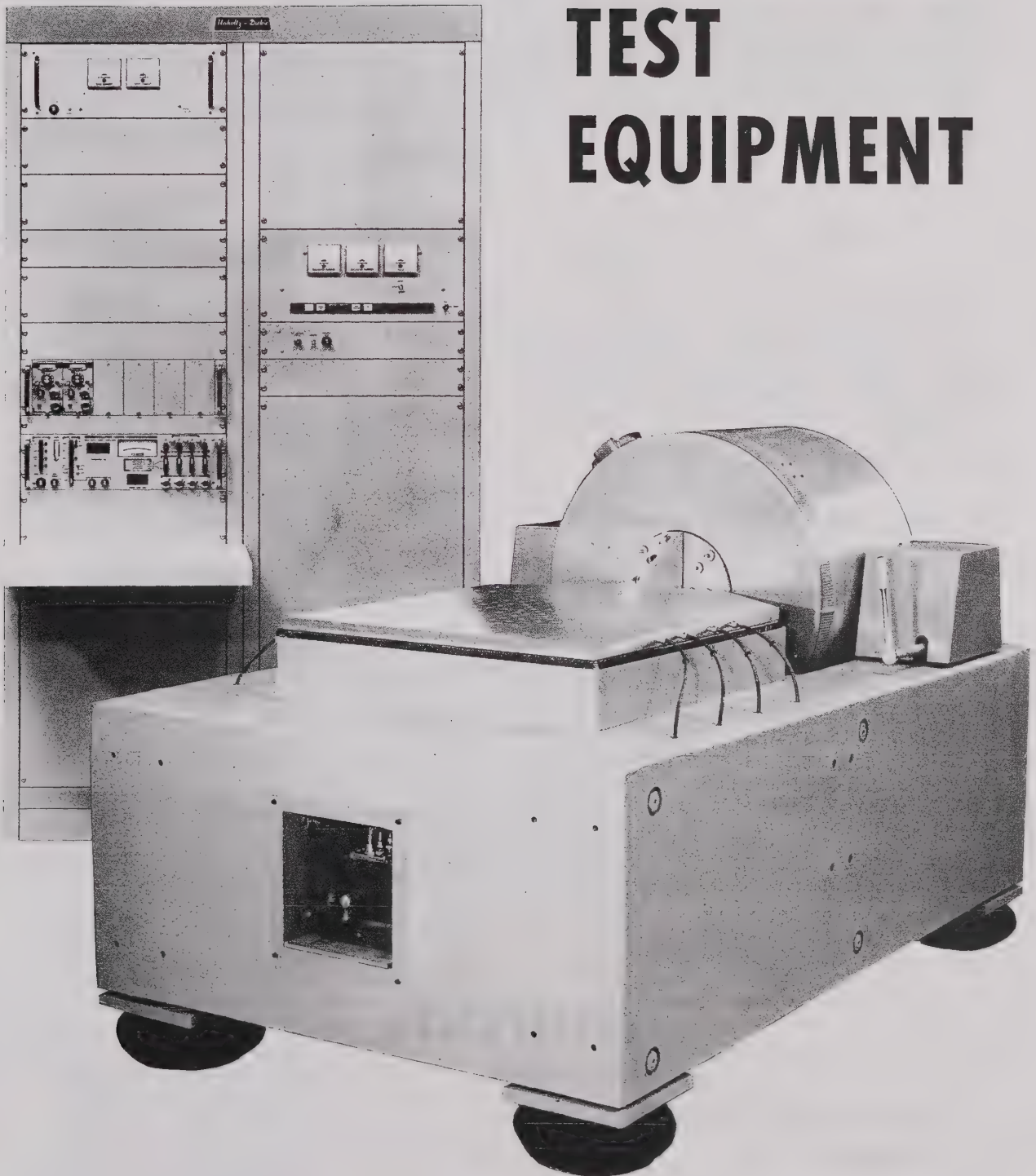
Internal colored flags indicate the active pushbuttons.

OPTIONS

The optional features described below are available for special customer requirements. The options are designated by adding the letters as suffixes to "TF22".

- L: An internal F-V converter is supplied for constant percentage BW control in situations where the tuning oscillator does not supply this signal.
- SR: A sine-reject output (rear panel BNC) is added, which provides a response notch at the tuning frequency. The SR output is necessary for combined sine/random testing, in which the sine component must be separated from the random component, and vice-versa, for control and analysis purposes.
- K: Two channels are provided so that the phase characteristic of one matches that of the other within $\pm 1^\circ$ from 5 to 5000 Hz. Phase-matched filters facilitate mechanical impedance measurements and transfer function analysis.
- F2: Operating range is changed to 2-2000 Hz and the 10% BW limits, to 1 and 100 Hz.
- F1: Operating range is changed to 1-1000 Hz and the 10% BW limits, to 0.5 and 50 Hz.
- BW5: The 10% BW is changed to 5% and the BW limits are changed to 1 and 100 Hz for the standard operating range of 5-5000 Hz.
- 8: The front panel height is changed to 8.75" to match the panel height of the D22 Series Signal Conditioners with the "-8" large meter option.
- P: The capability to measure and plot the power spectral density (PSD) of random vibration test data is added. The following section contains further description.

VIBRATION TEST EQUIPMENT



UNHOLTZ-DICKIE
CORPORATION

Vibration testing has been a major tool used in the development of military and space hardware for over 25 years. Today, the benefits of vibration testing are being applied in a variety of commercial and consumer product areas as well. This trend parallels an increasing number of federal regulations which require more comprehensive testing to assure product reliability and safety.

Vibration testing can genuinely benefit the manufacturer. By simulating environmental vibration levels during actual product development, the engineer can verify that a design is suitable for its application. This type of testing establishes performance and reliability prior to release of a design for production. Such an approach can save money by minimizing the probability of major redesign work, and even legal liabilities which may result from an inadequate product design. In addition, quality control procedures can be enhanced by using vibration testing as a tool to monitor the consistency of production methods and materials.

Figure 1. SETUP FOR AUTOMATIC SINE TESTING

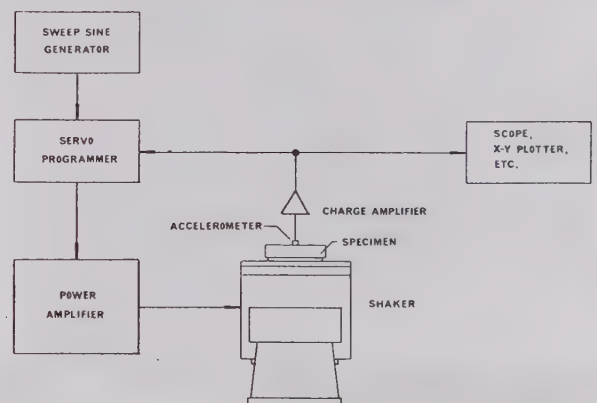
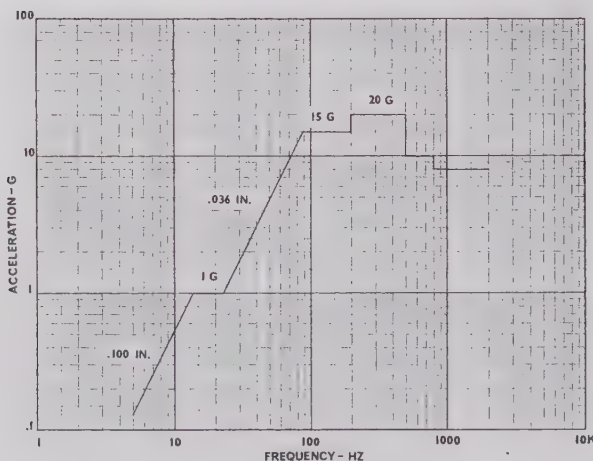


Figure 2. EXAMPLE OF TEST PROGRAM



The block diagram above could represent any of a wide variety of available vibration test systems. Unholtz-Dickie, the industry leader in solid state powered shaker systems, offers a complete line of vibration test systems as well as a full complement of signal conditioning and control instrumentation. See page 3 for a convenient listing of Unholtz-Dickie shaker systems. The remaining pages describe many of the instruments and system accessories that have helped make Unholtz-Dickie today's number one manufacturer of vibration test equipment.

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★ VIBRATION TEST SYSTEMS	3 - 7
★ CONTROLS	8 - 9
★ INSTRUMENTATION & MEASUREMENT	10-12

VIBRATION TEST SYSTEMS

Unholtz-Dickie produces vibration test systems for all test applications. Sine force ratings range from 50 including those with multiple shakers are also available. to 24,000 pounds. The table below lists these systems, with pertinent technical data. Special systems,

Every Unholtz-Dickie system includes a proven solid state power amplifier, and features reliable air cooling of the shaker armature. Systems engineering of each system component assures maximum performance and utilization, with simplified operation.

SYSTEM PERFORMANCE			SHAKER		
FORCE (lbs)		STROKE (inches, DA)	MAX. SINE PAYLOAD (lbs) at 20g	ARMATURE WEIGHT (lbs)	TABLE DIA (inches)
Sine (pk)	Random (rms)				
50	—	0.5	1.8	0.69	2
50 ¹	—	1.0	1.9	0.55	DRIVE ROD
150 ¹	—	4.0	5.2	2.25	DRIVE ROD
250	125	1.0	9.7	2.75	3.5
300	180	1.0	12.2	2.75	3.5
500	300	1.0	19.7	5.3	4.5
1,000 ¹	—	6.0	39	11	DRIVE ROD
1,200	600	1.0	46	14	5.75
1,200	600	1.0	40	20	8
1,700	850	1.0	71	14	5.75
1,700	850	1.0	65	20	8
3,000	2,200	1.0	134	16	5.75
3,000	2,200	1.0	128	22	8
4,000	3,300	1.0	171	29	8
6,000	3,000	1.0	264	36	12
6,000	4,500	1.0	264	36	12
7,000	4,000	1.0	300	50	12
7,000	5,500	1.0	300	50	12
8,000	4,000	1.0	310	90	16
9,500 ²	4,500	1.0	375	100	16
10,000	5,000	1.0	400	100	16
10,000 ²	6,500	1.0	405	95	16
12,000	6,000	1.0	510	90	16
12,000 ²	8,000	1.0	500	100	16
15,000 ²	9,500	0.75 ³	650	100	16
17,500 ²	12,000	1.0	780	95	16
19,000 ²	15,000	1.0	855	95	16
20,000 ²	14,000	1.0	905	95	16
22,000 ²	18,000	1.0	1,005	95	16
24,000 ²	20,000	1.0	1,105	95	16

NOTES:

¹ MODAL SYSTEMS (See PAGE 7)

² INDUCT-A-RING SHAKER (SEE PAGE 5)

³ 1.0 INCH STROKE AVAILABLE WITH REDUCED
FORCE RATING

SHAKERS

U-D shakers range in size from small, portable units for component-type testing, up to large machines for high performance testing of relatively massive specimens.

These shakers are generally categorized by a SERIES number, which indicates a basic frame size. Typical shaker models in the various SERIES are shown here. Special long-stroke shakers designed for "modal testing" are described on page 7.

SERIES 100

Max. Force Rating: **50 pounds** peak sine. For small component testing, especially to high frequencies. Portable. **Air cooled.**



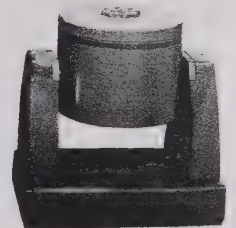
SERIES 200

Max. Force Rating: **300 pounds** peak sine. For component and sub-assembly testing. Can also be used in modal work. Portable, **Air cooled.**



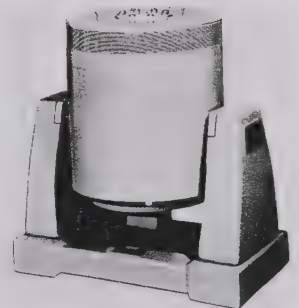
SERIES 300

Max. Force Rating: **500 pounds** peak sine. For component and sub-assembly testing. Also used in Transducer Calibration Systems (page 7). Water cooled field. **Air cooled armature.**



SERIES 400

Max. Force Rating: **1,700 pounds** peak sine. Available with 5 3/4" and 8" diameter tables. **Air cooled.**



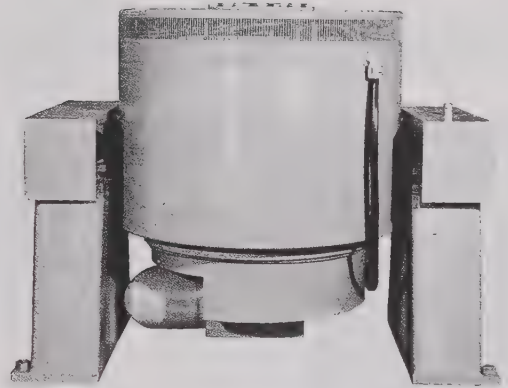
SERIES 500

Max. Force Rating: **4,000 pounds** peak sine. For testing of small components up to major assemblies. Available with 5 3/4" and 8" diameter tables. **Air cooled.**



SERIES 500

Max. Force Rating: **7,000 pounds** peak sine. Available with a light weight armature for high g testing, or heavier armature for more massive specimens. **Air cooled.**

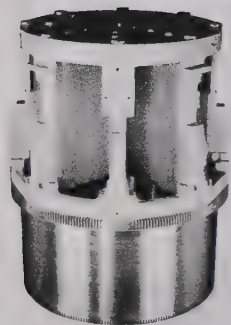
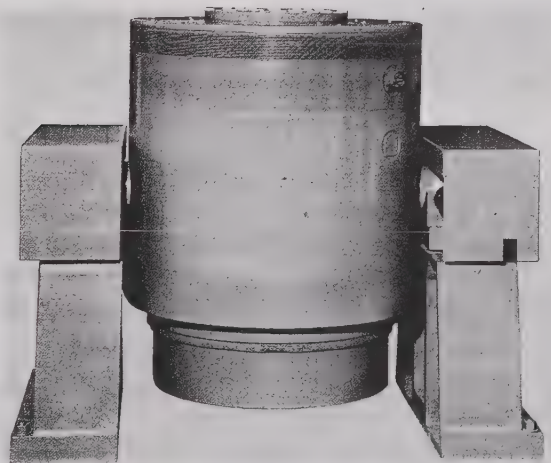


SERIES 1000

Max. Force Rating: **12,000 pounds** peak sine. U-D's largest wound-coil shaker. For testing small assemblies up to massive specimens. Water cooled field. **Air cooled armature.**

SERIES 1000W

Max. Force Rating: **24,000 pounds** peak sine. Features U-D's exclusive INDUCT-A-RING armature design (see below). For reliable, ultra high performance testing of small assemblies up to massive specimens. Water cooled field. Water or air cooled stators. **Air cooled armature.**



INDUCT-A-RING ARMATURE

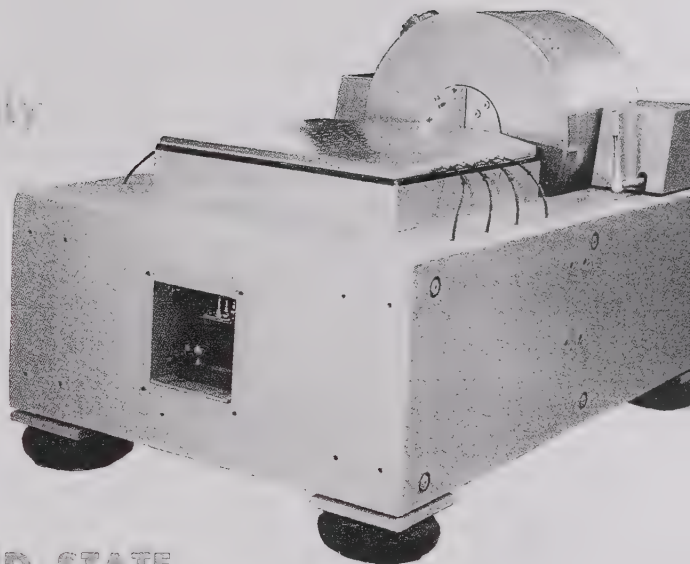
INDUCT-A-RING is the U-D trade name for a revolutionary armature design concept. The principle of transformer action is utilized to transfer energy from stationary AC driver coils (stators) to a moving element.

- The moving element is a simple two-piece metal structure. A single turn, solid metal armature coil is bolted metal-to-metal to the shaker table casting, providing the ultimate in strength and rigidity.
- All points on the vibrating member are at ground potential (zero voltage) at all times. There are no electrical windings or epoxy bonded joints. There is **no possibility of voltage breakdown**, and therefore no insulation is required.
- The solid metal, single turn ring is **air cooled**. Cooling connections subject to armature vibration are eliminated.
- AC currents are induced into the solid metal ring, **eliminating electrical connections** which bridge stationary and moving parts.

The INDUCT-A-RING armature is featured in 1000W SERIES shakers, rated up to 24,000 pounds peak sine force.

CSTA Combined Slip Table Assembly

The PERMALINE Combined Slip Table Assembly provides for testing in three axes while using only one fixture. Permanent factory alignment of the shaker and slip plate allows quick change from vertical to horizontal operation. In addition, no special floor construction is required since inflatable air mounts effectively isolate the entire assembly from the supporting structure.



SOLID STATE POWER AMPLIFIERS

U-D pioneered the use of solid state power amplifiers to drive electrodynamic shakers in the early 1960's. Advances in silicon technology have been combined with proven circuit designs to produce the present generation of amplifiers. This design has demonstrated reliable performance in hundreds of customers installations since its introduction in 1968. U-D's industry leading position as a supplier of solid state power is clearly demonstrated by the fact that U-D has delivered more kVA of solid state power than all other competitors combined. Over eight years of field proven reliability stand behind every U-D solid state power amplifier — a record unmatched in the industry.

EXPANDABLE, MODULAR DESIGN

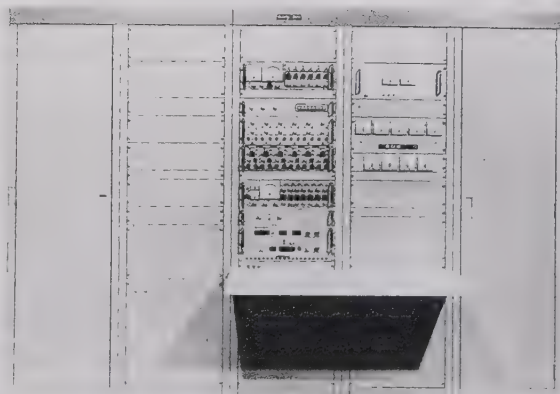
The basic power amplifier architecture provides for field expansion to higher output ratings. A given amplifier has one or more 16 kVA Output Assemblies. Amplifier expansion is accomplished simply by adding the required number of Output Assemblies to the predrilled mounting hardware.

EASILY ACCESSIBLE OUTPUT CIRCUITRY

All output power transistors are stud mounted in massive water cooled heat sinks. Amplifier shutdown or drainage of cooling water are not required to perform routine maintenance checks of the complete amplifier circuitry. All transistor terminals are physically accessible, permitting test point monitoring of individual transistors during actual amplifier operation.

SIMPLIFIED, RELIABLE WATER COOLING

The amplifier finals are premium grade, silicon alloy junction power transistors which are widely recognized for their nonaging ruggedness. The transistor collector is common to a threaded mounting stud, permitting direct contact between the stud and cooling water flow. The water cooled heat sink is designed to provide optimum turbulence around the transistor stud and mounting base. This design assures maximum cooling efficiency while retaining relatively large water passages.



128 kVA Solid State Power Amplifier
and System Control Console

MODAL SHAKER SYSTEMS

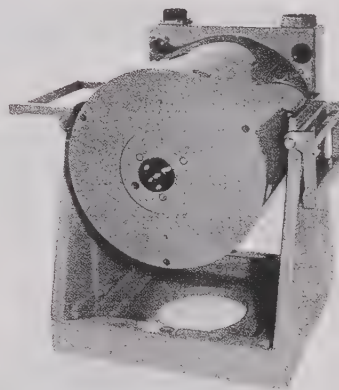
Unholtz-Dickie manufactures a family of shakers designed specifically for "modal" testing. These shakers feature long stroke, low internal damping, and near zero axial spring rate. These special characteristics facilitate the excitation of pure structural modes, especially when multiple shaker arrays are utilized. The shaker moving element includes a hardened output shaft for connection to the test object.

These modal shakers incorporate a double ended field structure, providing parallel flux paths from above and below the magnetic air gap. This design gives maximum magnetic flux linkage with the armature coil, and assures optimum waveform purity. Uniform flux density throughout the operating stroke provides output force proportional to armature current, independent of armature position.

When driving power is provided by a U-D solid state power amplifier with "current feedback," these shakers can be operated as **constant force** generators. In this operating mode, shaker armature current is proportional to power amplifier input voltage through large variations of load impedance; therefore, the magnitude of the generated AC force in the armature coil remains constant as a function of frequency. This constant force characteristic also requires the shaker to have a "force/armature current" ratio reasonably independent of armature position, as described earlier. Constant force sweeps can be performed without force links, external servos, or tracking filters.

Three basic models are available. The Model 1 is a 50 pound force, permanent magnet design with a one inch stroke. The Model 4 is a four inch stroke shaker rated up to 150 pounds force. Both of these units feature folding-type carrying handles which enhance portability.

The Model 6 Shaker generates up to 1000 pounds force and provides a full six inch stroke. This shaker is frequently used to generate low frequency motion in seismic simulation studies, or for vehicular studies in aerospace applications.



MODEL 4

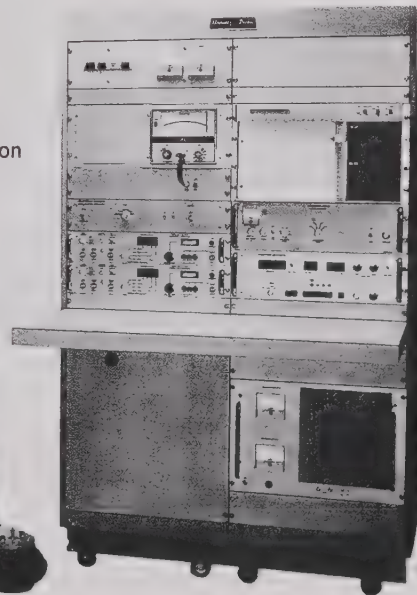
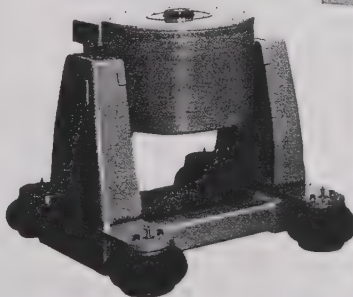
SERIES 300 VIBRATION TRANSDUCER CALIBRATION SYSTEMS

The Series 300 Calibration Systems are offered with manual controls for point by point calibration, or with frequency sweeping controls giving an automatically drawn curve of % deviation of the "unknown" transducer sensitivity relative to the "reference" accelerometer, as a function of frequency. Original data is permanently plotted, eliminating operator errors in readout and transcription.

At full system performance, and with automatic servo controls operating, acceleration waveform distortion is less than 1.5% at all operating frequencies. The overall system noise level is less than .005 g rms. Automatic plotting systems feature 0.25% plotting resolution of the unknown transducer output relative to the reference.

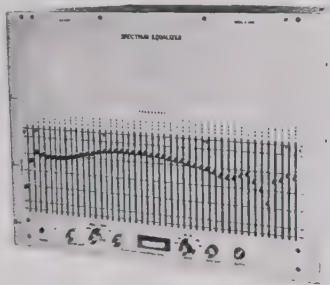
Model 351

Automatic Recording Vibration
Calibration System with
Optional VI100 Shaker
Vibration Isolation

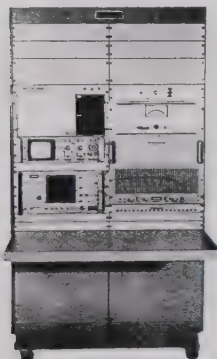


RANDOM ACCESSORIES

Complete random testing capability is available with systems-engineered random accessories. A typical remote random control console configuration is shown here.



Random Accessories include the Model E109B Spectrum Equalizer, featuring 45 active filters with individual, rectilinear motion attenuation controls. Convenient equalization can be performed using this unit in conjunction with a real time analyzer.



AUTOMATIC SINE CONTROLS

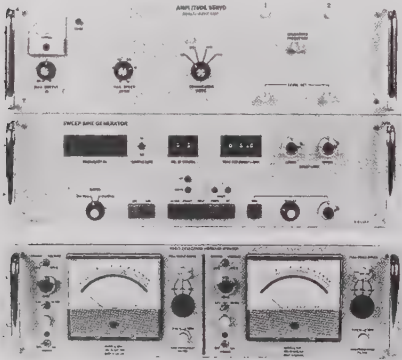
Three automatic sine control systems are available. Each is a complete control system, including everything necessary to conduct sophisticated sinusoidal vibration tests. Each control system includes a **zero static error servo**. This feature allows large gain changes in the compressor (AGC) circuitry without introducing static errors in the actual control level. Many other desirable features are described below. Select the control combination which best fits your requirements.

BASIC



The **OSP-4 Oscillator-Servo-Programmer** is our most economical, compact sine control system. This unit combines the following features in a single chassis: a sweeping digital sine generator, frequency counter, vibration meter, servo control, four-level programmer, and input charge amplifier. Frequency range: 5 to 5,000 Hz.

LOW FREQUENCY

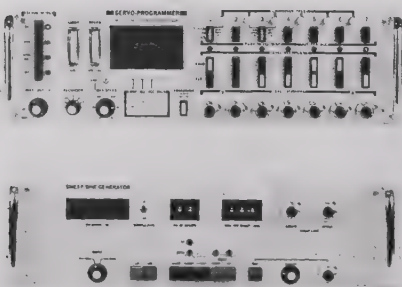


Superior low frequency control is provided by the **OSC-1L Sweep Sine Generator** and **SP-2L Servo Programmer**.

The **OSC-1L** is a sweeping digital sine generator which operates from 1 to 5,000 Hz. A built-in frequency counter samples and displays ten times per second even at 1 Hz. Sweep rate and number of sweeps may be preselected to provide automatic test shutdown.

The **SP-2L** is a low frequency, 2-level servo which operates from 1 to 5,000 Hz. This unit is designed for use with the 2610RM-1 dual channel signal conditioner which provides precision readout for each program level. Servo control on acceleration, velocity or displacement to 1 Hz is provided, using the 100PA Accelerometer. The 100PA also permits high frequency operation to at least 2,000 Hz.

DELUXE



The most comprehensive sine control system available in the industry consists of the **OSC-1S Sweep Sine Generator** and **SPA-7 Servo Programmer**.

The **OSC-1S** is a sweeping digital sine generator which operates from 2 to 5,000 Hz. A built-in digital frequency counter reads and displays ten times per second even at 2 Hz. Sweep rate and number of sweeps may be preselected to provide automatic test shutdown. A sawtooth generator output permits synchronous scope display of the vibration waveform.

The **SPA-7** is a programmable seven-level servo. Digital display of acceleration, velocity or displacement is provided, plus automatic or manual modes for selecting the crossover frequency between program segments. An input charge amplifier is standard.

SPECIAL CONTROLS



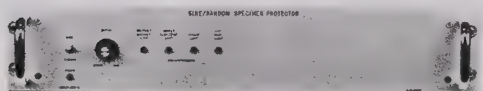
Model RD-1 Resonant Dwell Control automatically maintains the vibration testing frequency at the resonant frequency of a test specimen during fatigue testing.



Model MAO-6 multifunction Averaging Control features eight individually selectable data channels for control to the average signal level. Can be used for sine or random vibration testing.



Model SRP-3 Sine/Random Protection System automatically switches to the highest (or lowest) acceleration input. Accepts up to six acceleration signals, and gates to the output whichever signal reaches its preset limit.



rapidly — as rapidly as 100 microseconds, depending on the operating frequency at the time of shutdown.

Specimen protection limits are defined by presetting a group of system interlock sensors, which monitor such parameters as amplifier voltage, amplifier current, and shaker stroke. Each sensor can be adjusted to function at two discrete levels. The **first** setting of each sensor is adjusted to trip at some increment above the normal maximum operating level of a given test. This first level activates the amplifier input compressor. If compression removes the "overtest" condition, no further shutdown sequencing occurs. The amplifier remains on the air, but with essentially zero input signal.

If this first compression sequence does not remove the overttest condition, a complete amplifier shutdown sequence is initiated as soon as any of the interlock sensors reaches its **second** preset limit. The complete shutdown sequence consists of the following action: 1) compression is again triggered if not already complete; 2) output power transistors are disconnected from the preamplifier; 3) main power contactors are released. This final shutdown function is designed specifically to prevent contactor transients from reaching the amplifier finals.

The SRP-3 Protection System operates for sine or random testing, and is optionally available on new vibration test systems. Consult factory for further details.



Model RD-2 Resonant Dwell Counter indicates the number of stress cycles accumulated by a specimen undergoing a resonant dwell test. Counter may be preset to initiate automatic shutdown after completion of desired number of stress cycles.

Model IF-11 Tracking Filter provides constant 10% bandwidth or fixed 2 to 200 Hz bandwidth filtering, plus a log DC output for X-Y plotting. Economical, modular construction.

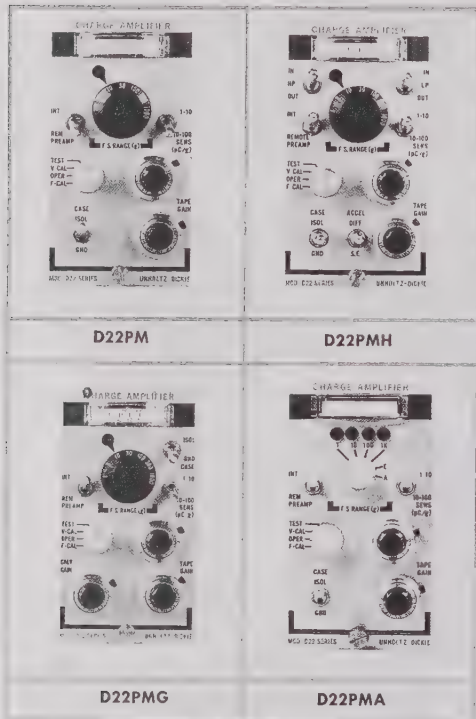


Model VML-1 Vibration Monitor-Limiter offers independent overttest protection for shaker systems. Adjustable shutdown limits are provided for both acceleration and displacement. Protection circuits operate for sine or random testing and provide soft, rapid shutdown.

The Model SRP-3 Sine/Random Protection System provides **comprehensive** protection for vibration test specimens. Variable speed signal compressor circuitry is connected to the power amplifier input. This compressor automatically reduces the amplifier input signal to zero whenever amplifier shutdown is imminent. Compression is performed smoothly yet

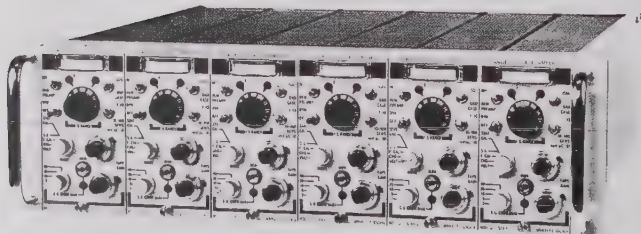
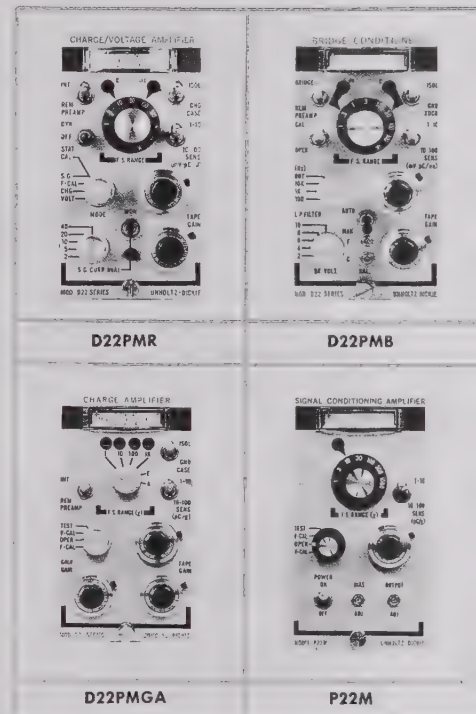
D22 SERIES

The D22 Series provides charge amp signal conditioning for all piezoelectric transducers. Some models also provide for strain gage operation. This series features all integrated circuit design with superior low noise characteristics, in a rugged modular construction. The basic Model D22PM includes the capability of operating with a remote preamp, and includes a meter. This and other standard models are shown below. The wide range of optional features available for addition to most models, is listed below.



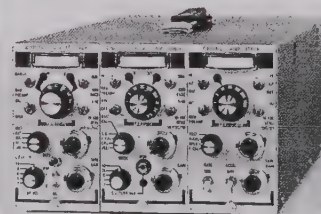
D22 OPTIONS

Description	Suffix
STRAIN GAGE OPERATION	R
HIGH TEMP ACCEL. INPUT	H
BRIDGE CONDITIONER	B
10 mV/g SERVO OUTPUT	S
100 mV-SEC/IN. VEL. OUTPUT	I
1 V/IN. DA DISP. OUTPUT	II
LINEAR DC OUTPUT	F
LOG DC OUTPUT	L
REMOTE RANGE CONTROL	E
AUTORANGING	A
±100 mA LINE DRIVER	C
±100 mA GALVO OUTPUT	G
CALIBRATION OSCILLATOR	O
TRACKING FILTER CONNECTION	T
0.5 HZ FREQ. RESPONSE	-2
EXTRA X10 GAIN	-3
FS RELAY CALIBRATION	-4
LARGE 2½" SCALE METER	-8



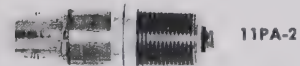
The Model 22RA Rack Adapter accepts six 22 Series modules in the standard 5¼ inch panel height. Also accepts the Model TF11 Tracking Filter (see page 9).

22RA



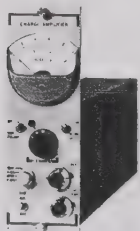
22P3

The Model 22P3 Three Channel Portable Adapter accepts three channels of 22 Series instruments.



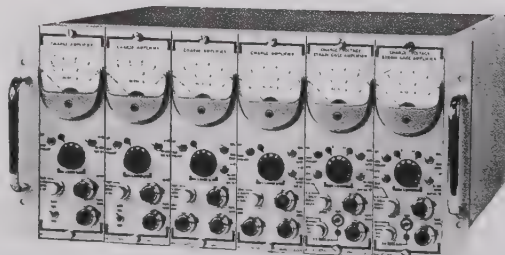
11PA-2

The Model 11PA-2 is a two-wire Remote Voltage Preamp designed for use with any of the 22 Series instruments.



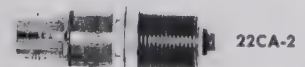
D22PM-8

Models D22PM and D22PMR are available with the "-8" option, which provides a 2½ inch meter scale for easier readout.



22RA-8

Rack mounted D22's with the "-8" large meter option require the 22RA-8 Rack Adapter with 8¾ inch panel height. Each 19 inch adaptor accepts six "-8" modules.



22CA-2

The Model 22CA-2 Remote Charge Preamp may be used with any of the 22 Series instruments shown above, and is a companion unit to the Model P22M. Optional Model 22CA-2T is available for operation to 160°F.

1. RANGE (g)

2. RANGE (g)

3. RANGE (g)

TUNE (g)

SEEK (g)

TUNE (g)

WHITE 1.0 CAL.

REVERSE 1.0 CAL.

WHITE 1.0 CAL.

DOUBLE INTEGRATING POWER

CHANNEL A CHANNEL B

LOCAL POWER

100-1000 100-1000

ACCELEROMETERS

Unholtz-Dickie produces a full line of piezoelectric accelerometers for general purpose vibration testing and for many special applications. Subminiature, light weight models are offered for high frequency requirements. High sensitivity models give maximum signal/noise ratios for low level measurements.

The **Model 10B10** and **10B10T** feature a factory adjusted sensitivity of exactly 10 pC/g. This convenient normalized sensitivity allows multi-channel charge amplifier configurations to be set for one input sensitivity, which then permits complete accelerometer interchangeability. Thus, a major source of instrumentation error can be eliminated.



10B10T



100PA

The **Model 100PA** is a 100 mV/g, low output impedance accelerometer that is particularly well suited for wide dynamic range acceleration measurements and reliable, low level displacement measurements requiring double integration. Accurate, low level displacement data at 1 Hz is easily obtainable. The 100PA is typically used with the 1610M Vibration Monitor or 2216 Signal Conditioner (page 11).

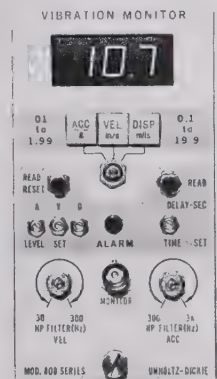
INDUSTRIAL VIBRATION MONITORING

The **U-D 8800 Series Industrial Accelerometer** and **800 Series Vibration Monitor** represent a thoroughly engineered sensor/instrument system for machinery health monitoring. Monitoring is accomplished with the low output impedance 8800 accelerometer featuring simple installation and a rugged two-wire cable, plus the modular 800 Series Vibration Monitor.

The **8800/800 Series** approach takes unique advantage of the TOTAL vibration spectrum by placing equal emphasis on **displacement** measurements in the lower frequency range, **velocity** measurements in the mid-frequency range, and **acceleration** measurements in the high frequency range. Simultaneous monitoring of all three vibration parameters utilizes information that is essentially wasted by proximity probes or velocity pickups.



8803



841B

The **Model 1602 Transducer Tester** is a single frequency, portable test stand which may be used to verify the operation of any vibration transducer. An internal reference accelerometer is utilized to monitor actual test table motion, which is displayed in terms of acceleration, velocity, or displacement on a convenient digital readout. Driving power and controls are self-contained. The dynamic response of the test table can be "tuned" to give maximum response with different table loads. Thus, a wide range of transducer weights may be accommodated.



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PSD ANALYSIS (OPTION P)

For sweep-sine testing the TF22-P is used as a standard tracking filter by appropriately selecting the HI LIMIT, AUTO, or LO LIMIT modes. This configuration can be converted for power spectral density (PSD) measurement by selecting the RANDOM mode. A typical system interconnection is shown in Fig. 1.

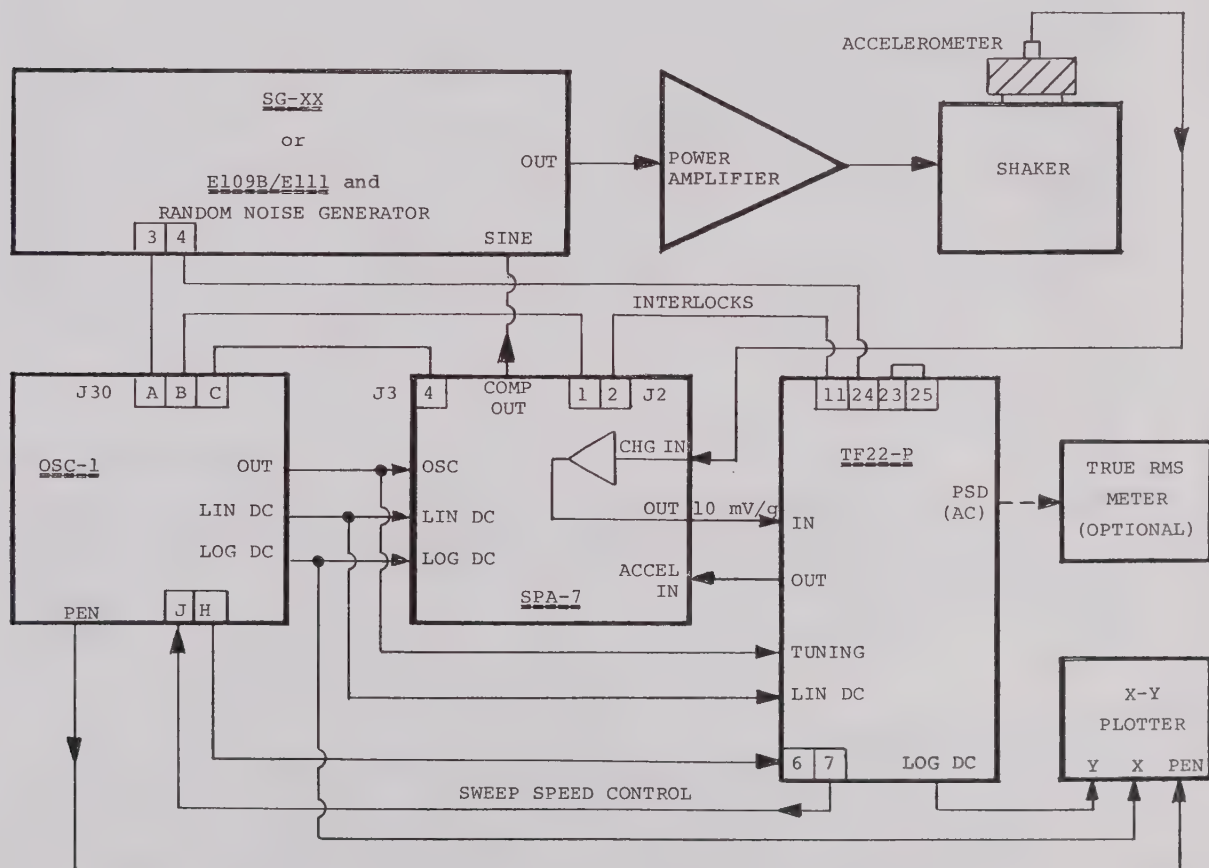


FIG. 1 TYPICAL INSTRUMENT INTERCONNECTIONS FOR SINE AND RANDOM VIBRATION TEST SYSTEM

The OSC-1 generates a tuning signal which the TF22-P tracks during the analysis period. The TF22-P is intended for spectral analysis in the band from 20 to 2000 Hz. It provides an analysis BW of 20 Hz in the frequency range from 20 to 200 Hz and automatically switches to a 50 Hz analysis BW for frequencies above 200 Hz. In addition, when the bandwidth is switched, the TF22-P also automatically changes the gain at the filter center frequency to accommodate the change in BW, changes the averaging time, and optimally controls the sweep rate for the OSC-1.

The PSD is plotted directly on an X-Y recorder using the LOG DC output from the TF22-P and the LOG FREQ output from the OSC-1. About five minutes is required for a spectral analysis from 20 to 2000 Hz. The CAL mode switch provides an internal calibration signal to facilitate the adjustment of the Y-axis sensitivity of the recorder. A separate AC output proportional to PSD is also available for monitoring PSD on an optional true rms voltmeter.

SPECIFICATIONS

INPUTS

Signal

Frequency Range: 5 Hz to 5 kHz
 g Ranges: 10, 30, 100, 300 and 1000 g (peak) nominal
 Overload: The overload detector activates at approx. 1 dB above full scale
 Sensitivity: 10 mV peak/g peak
 Impedance: 20 kilohm

Tuning

Frequency Range: 5 Hz to 5 kHz
 Amplitude: .3 V to 3 V rms sine wave
 Impedance: 20 kilohm

DC vs Frequency (generated internally on TF22-L)

Amplitude: 10 mV at 5 Hz to 10 V at 5 kHz, linear DC voltage vs frequency used to program filter bandwidth
 Impedance: 10 kilohm

OUTPUTS

Filtered Signal

Frequency Range: 5 Hz to 5 kHz
 Amplitude: Unity gain to ± 0.2 dB at 500 Hz
 Frequency Resp.: ± 0.2 dB
 Impedance: 50 ohm, 2 mA pk-pk max.
 Linearity: ± 0.2 dB $\pm 0.3\%$ of full scale, 0 dB to -50 dB at 500 Hz
 Noise: 74 dB below full scale +0.1 mV rms at 500 Hz

Log DC

Amplitude: 50 mV/dB, 0 V at F.S. (-2.50 V at -50 dB)
 Conformity: ± 0.25 dB, 0 to -40 dB; ± 1 dB to -50 dB
 Impedance: 50 Ω

FILTER

Bandwidth: 10% of tuning frequency between limits
 Bandwidth Limits: Lower limit 2 Hz - 20 Hz; Upper limit 20 Hz - 200 Hz
 Filter Response: Minimum 50 dB rejection at ± 8 times half - BW points (approx 3 pole Butterworth)

CONTROLS

Interlocking push-button controls for F.S. RANGE, and BANDWIDTH selection. Green background shows active push-button. Filter IN/BYPASS control shows green background in BYPASS position.

INDICATORS

Overload (Red): Indicates overload of input
 Lo Limit (Green): Indicates BW is fixed at lower limit
 Hi Limit (Green): Indicates BW is fixed at high limit

INTERLOCKS

Depressing any front panel push-button or triggering the overload detector provides a signal to place the vibration system into STANDBY mode (no vibration).

CONNECTORS

Rear panel BNC connectors are provided for all input and output functions. Parallel front panel BNC connectors are available for input signal and filtered output signal. A 25 pin "D" series connector is used for interlocks and for patching tuning signals between modules in a multiple channel installation.

PHYSICAL

Power: 105-125/210-250 V AC 50-60 Hz, approx. 10 VA
 Weight: 6 lbs.
 Size: 5.25H x 2.8W x 18"D excluding connectors. Uses Model 22RA Rack Adapter for six channels
 Finish: Front panel - Amco light grey metallic paint, grey vinyl-covered chassis.

ADDITIONAL SPECIFICATIONS FOR TF22-P:

CALIBRATION MODE

A 22.4 mV rms sinusoidal signal replaces the input signal to assist calibration of the X-Y plotter.

RANDOM MODE

Filter bandwidth, averaging time constant, oscillator sweep speed and AC filter gain are automatically switched at a tuning frequency between 200 and 250 Hz. The parameters follow:

	FILTER BW	TIME CONST	SWEEP SPEED	AC GAIN
BELOW 200 Hz	20 Hz	1.25 Sec	1.6 Hz/Sec	~ 5.6
ABOVE 250 Hz	50 Hz	.5 Sec	10 Hz/Sec	~ 3.6

SIGNAL INPUT (Random Mode)

Frequency Range: 20 to 5000 Hz (Spectral band at least 500 Hz wide)
 Full Scale Ranges: 100, 10, 1, .1, .01 g²/Hz corresponding to front panel ranges of 1000, 300, 100, 30, 10 g pk
 Maximum Value: RMS value should be limited to no more than 1/3 of the rated peak value.

PSD OUTPUT - AC signal

Gain: 1000 g pk (100 g²/Hz) range - see previous table
 Output: Approximately 2.5 V rms for full scale value regardless of center frequency
 Noise: 54 dB below full scale output +.3 mV rms at 500 Hz.

LOG DC OUTPUT

Random Mode: -0.5V DC at full scale; 50 mV/dB. (-2.50 V at -40 dB). Statistical accuracy approx. ± 1 dB with 95% confidence. Approx. 6 dB to 10 dB above full scale is possible if maximum input value is not exceeded.
 Calibration Mode: -2.50 -2.00, -1.50, -1.00, -0.50 V DC ± 10 mV for 1000, 300, 100, 30, 10 g pk full scale ranges respectively. Calibration signal represents .01 g²/Hz.

INTERLOCKS

System interlocks interrupted in CAL mode prevent erroneous system operation.

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Bulletin TF 22

UNHOLTZ-DICKIE CORPORATION

Incoming Instrument Inspection and Return Shipping Instructions

1. Unpacking and Inspection

If the shipping carton is damaged, note on acceptance that it is received damaged and subject to claim when inspected. Ask that the carrier's agent be present when the instrument is unpacked and inspected for damage (scratches, dents, broken knobs, etc.). If the instrument is damaged or fails to meet specifications, notify the carrier and the Unholtz-Dickie Corporation immediately. Retain the shipping carton and the padding material for possible return for repair or further inspection by carrier. The purchaser and Unholtz-Dickie Corporation will arrange for the replacement and/or repair of the damaged item.

Refer to our separate warranty page for a statement of our warranty policy.

2. Return Shipment

Return shipment procedure: Please be sure the following instructions are observed if a Model 22 Series instrument is being shipped back to Unholtz-Dickie for repair, replacement, or upon completion of use as a demonstrator or loaner.

2.1 Size of Box and Packing Instructions

2.1.1 Single Channel with 5½ inch Panel Height

If the single channel was shipped from Unholtz-Dickie as an individual unit, replace the instrument in its original container. If the instrument was shipped as part of a rack mounted combination of channels, the single channel can be returned separately in a container that is no smaller than 22½ inch x 10½ inch x 9½ inch. The front and rear panels must be completely protected by approximately 2 inches of cushioning material. The top, bottom and sides must be surrounded by cushioning and filler materials. A strong, double wall type corrugated box, (350 lb/sq. in. minimum bursting test) has been proven to give adequate service. DO NOT USE A SMALLER OR WEAKER CONTAINER THAN THAT RECOMMENDED ABOVE.

Cover the painted surfaces of the instrument with protective wrapping paper or a plastic bag whenever the packing material might be coarse enough to scratch the painted surfaces.

2.1.2 Six Channel Rack with 5½ inch Panel Height

CAUTION: Do not rest the rack type instrument in a vertical position with its weight on the rear since the connectors and switches at the rear of the instrument might be damaged.

Replace this instrument in the original container. Replace all packing pads and fillers in the exact position which they originally occupied. If the original container is no longer available, use a container that is no smaller than 27 inch x 20½ inch x 10½ inch.

It is important that protection be provided for the rear connectors and switches during shipment. A sheet of stiff cardboard should be placed under the instrument and then folded up to meet the top of the rear panel. The instrument should be bagged and surrounded on all surfaces by cushioning and filler materials. A strong, double wall type corrugated box (350 lb/sq. in. minimum bursting test) has been proven to give adequate service. DO NOT USE A SMALLER OR WEAKER CONTAINER THAN THAT RECOMMENDED ABOVE.

2.1.3 Single Channel with 8-3/4 inch Panel Height

Follow the instructions given in paragraph 2.1.1, except that extra precautions must be taken to prevent the front panel extension with its meter from being bent during shipment. The extended meter must be braced between packing material so that the load force will be distributed evenly over the entire front panel of the instrument.

2.1.4 Six Channel Rack with 8-3/4 inch Panel Height

Follow the instructions given in paragraph 2.1.2, except that the container size must be no smaller than 26½ inch x 25 inch x 13½ inch.

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MP MASTER



MA29934